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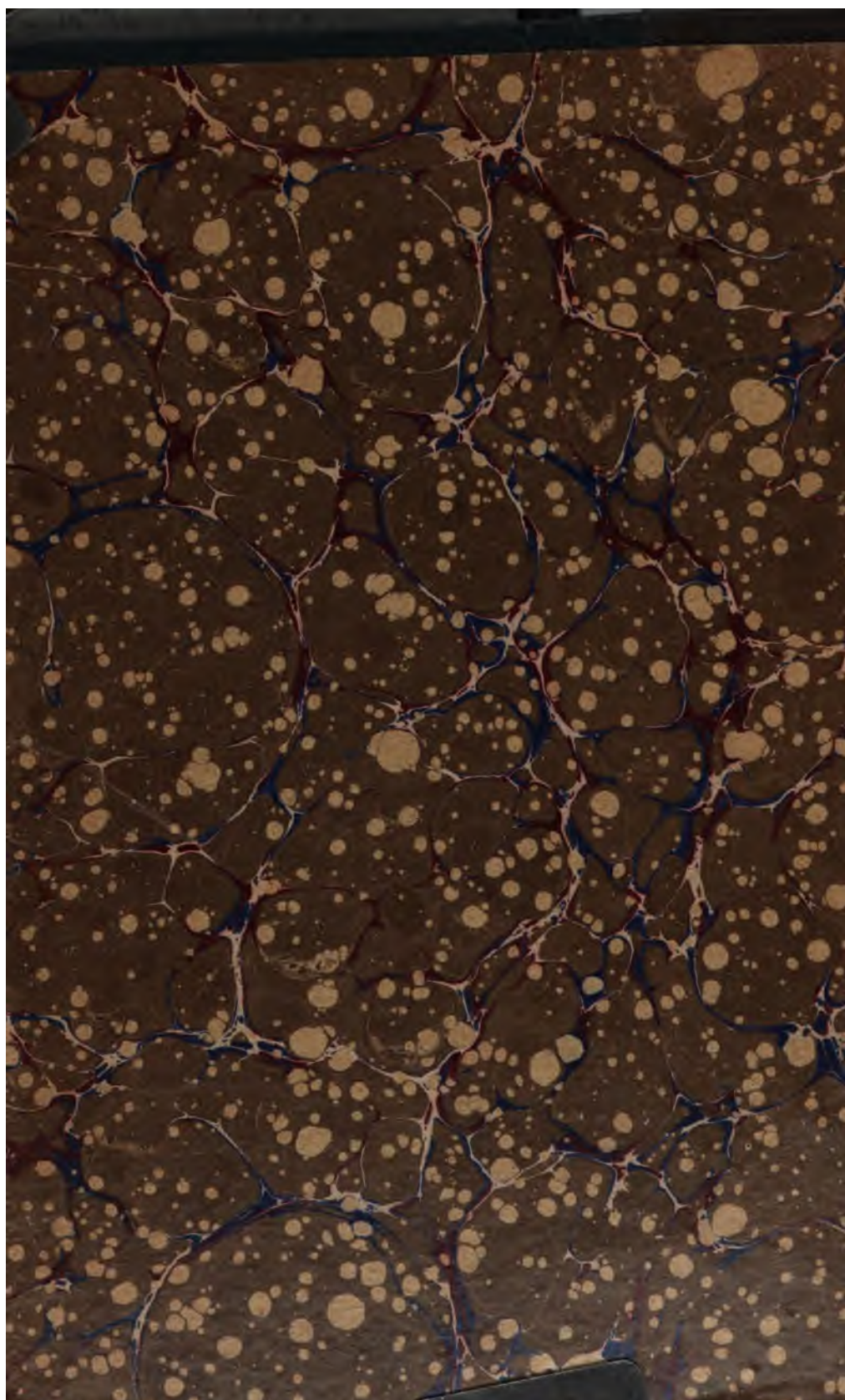
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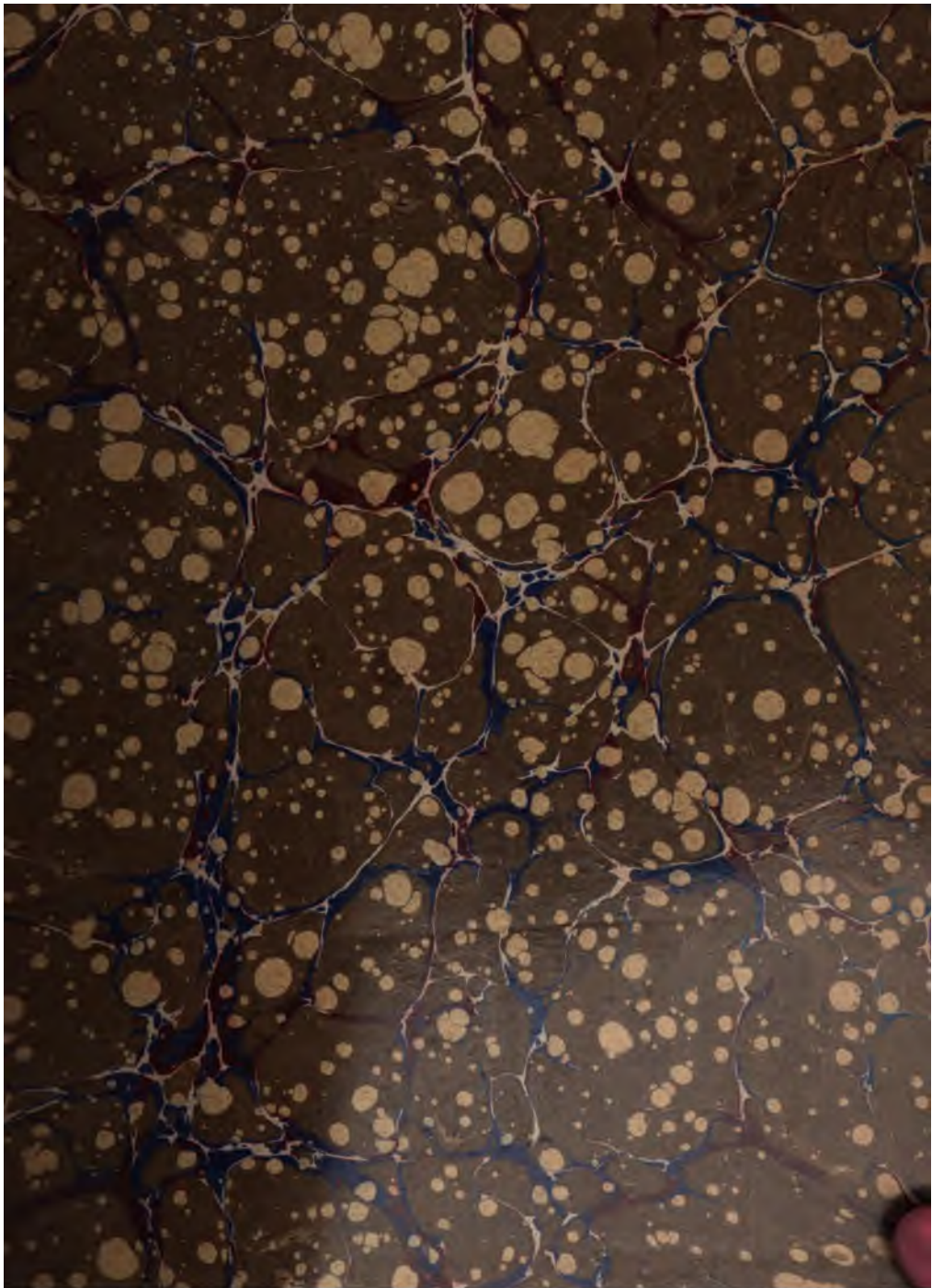
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THE MONIST

A QUARTERLY MAGAZINE

Devoted to the Philosophy of Science

Editor: DR. PAUL CARUS.

Associates: { E. C. HEDGECOCK,
MARY CARUS.

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CHICAGO

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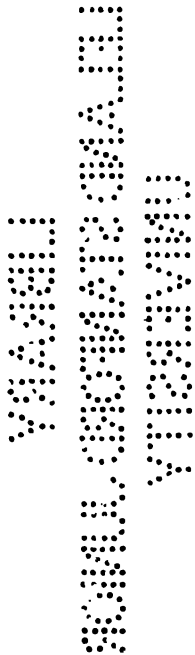
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THE MONIST

ON THE FORM AND SPECTRUM OF ATOMS.*

[This article was an address delivered by the author as the official rectorate address in his capacity of Rector Magnificus of the University of Munich. It was published in the original German in the *Süddeutsche Monatshefte* for September, 1905. The present translation, sanctioned and revised by the author, is augmented by additional remarks and diagrams.]

CHEMISTRY teaches that all earthly matter is composed of some seventy so-called elements. The exact number does not concern us here; it will probably increase with the further improvement of our methods of observation. But the fact which claims our attention is that the apparently endless variety of all material phenomena, whether of organic or inorganic nature, are built up from so small a number of different substances—or rather that the number should be limited at all.

In what does the difference between these substances consist? The chemist provides some marks of distinction in his analyses—the color and form of the crystals precipitated by certain reactions, etc. In this way however only the most peculiarly characteristic properties are distinguished. The problem of the intrinsic nature of the different elements remains unsolved. Perhaps we may doubt if this question can be answered at all. In contrast to philosophy, natural science shows only that these distinctions exist, and that there are means by which they may be closely classified. Scientists are content to be limited to

* Translated from the German by Lydia Gillingham Robinson.

this classification; but even if they wished to go further, the line that divides the known from the unknown might perhaps shift its position but could never be removed. Nevertheless it may be profitable to attempt to formulate quantitatively at least the question in regard to the qualitative differences of matter; e. g. to reduce it to the purely geometrical question of form. Of course in analytical geometry every problem of form is easily expressed in terms of quantity, hence we would have the proposition comprehended with mathematical precision, and so at least simplified.

From time immemorial ideas in regard to the actual unity of matter have been generally current. Mechanics and astronomy deal with the concepts of weight and mass only, without having reference to any distinction between the various chemical elements. They presuppose as their foundation the idea of the unity of matter, wherein a common property of all matter is postulated.

The atoms of the chemist are the smallest divisions of matter that can either exist alone or can enter into combination with other atoms. This does not prevent them from being themselves composed of still smaller particles which, however, cannot be isolated. In fact one of the very latest beliefs is that even in this respect a step forward can be made; that a disruption of atoms may actually take place under the influence of electrical forces in the so-called Geisler, or Crookes, or Hittorf tubes; that the so-called cathode rays may prove to be nothing else than the paths of dispersed molecules. Even experiments with the mysterious radium seem to point toward the possibility of so confining these ultimate atoms (*Uratome*) that one element may be changed into another, that out of radium, helium may be produced. The outcome of these experiments is still uncertain, but at least it is incontestable that these latest speculations in physical sci-

ence have succeeded in restoring and popularizing the conviction of the essential unity of all matter.

If the mathematician wishes to handle the proposed question with his own peculiar expedients he must first of all single out of the great variety of chemical properties, one that is accessible to quantitative representation, and which pertains only to the atom and not to groups of atoms such as crystal formations.

Each element has its particular spectrum consisting of a certain number of well-defined lines, by which the element may be positively recognized; i. e., in a gaseous and incandescent state (where the separate atoms circulate freely) each element, and therefore each single atom of the element, emits a light that when observed through the spectroscope does not furnish a continuous many-colored image, as for instance sunlight; but instead, a number of distinct lines whose position can be determined with extraordinary exactness, and each of which corresponds to a quite definite wave length of the particular light-vibration which exactly defines its own color. These wave lengths are numbers, hence quantitative sizes, by means of which all qualitative properties of the element concerned must be fully determined.

From these numbers the mathematician will proceed. He has the following problem before him: In space which is otherwise empty (occupied only by luminiferous ether) floats a material particle from which proceeds a series of vibrations each with clearly defined wave lengths, which are diffused in all directions and become visible as light of definite colors; what properties must this particle possess in order to produce light-vibrations having only these definite wave lengths or groups of wave lengths, and no others? The mathematical treatment is concerned only with the form of the particle and the distribution of matter within it, i. e., the density and elasticity of this matter.

But for such treatment the statement of the question must first be thus reversed: Given a particle of matter of a certain form, density and elasticity, that floats freely in luminiferous ether, what kind of light-vibrations originate from it? i. e., what are the wave lengths of the vibrations peculiar to it (the so-called *Eigenschwingungen*)?

So stated we have to do with a well-defined mathematical problem of the theory of partial differential equations; the matter composing the particle is set in motion (perhaps by contact with other particles); these vibrations continue in the surrounding ether throughout the surface of the particle without in any way interrupting the continuity in the motion of the wave through its surface; by this means is mathematically determined a definite or an infinitely great number of possible wave lengths, which produce an equal number of separate, distinct lines in the spectrum.

We must now vary the density, elasticity, form and size, in order to see whether through these can be reached the empirically established laws of distribution of the spectral lines of certain elements. Unfortunately the mathematical problem is so complicated that it is capable of detailed treatment only for a limited number of cases; and even then the equations are so extraordinarily intricate, that for the most part it must suffice to discuss the mathematical solutions only so far that the general type for the laws of the distribution of spectral lines may become apparent; and many elements too, on the other hand, are sufficiently characterized by this general type.

The simplest possible case is the following: The atom under consideration has the form of a sphere and is composed of matter of a given density and elasticity; what light-waves does this sphere generate? Here the calculation may be carried pretty far; the spectral lines are found to be distributed in the spectrum according to a simpler law than any to which an element has yet been

experimentally found to conform. Although it is enough in many problems of mathematical physics to represent atoms as spherical (especially in most problems of the kinetic theory of gas) yet atoms of an exactly spherical form are hardly ever met with.

Nevertheless the formulas which are valid for the sphere suggest a practically realizable result. When two spheres are composed of matter of equal density and elasticity but differ in size, we have the following law: If the lines of the spectrum for the light emitted by one of the spheres is known, those of the other may be found by multiplying the wave length of the known line by the ratio of the radii of the two spheres. Now if the spheres are of equal density, the ratio of the radii is equal to the cube root of the ratio of the weights of the spheres, or, in other words, the atomic weights of the two elements whose atoms are represented by the spheres. In this form then, the law becomes generally valid: The wave lengths of the spectral lines of two atoms of equal form, density and elasticity, similar to each other and differing only in size, are in the same proportion as the cube roots of their chemical atomic weights. According to this law the lines of one element may be computed from those of the other.

This law may easily be put to a practical test, and for this purpose it is necessary only to compare the spectral lines of different elements in the carefully prepared tables at our disposal. From this it follows that the spectra of the following groups of metals fulfill this law, either entirely or approximately:

1. Zinc, cadmium and mercury.
2. Magnesium, calcium, barium and strontium.
3. Silver, copper and gold.

These are groups of elements which are related in other respects because of their chemical properties. From their atoms we can tell that the elements of each group

are similar to each other ; but on the other hand, similarity in chemical relations does not in the least imply similarity in the form of atoms. Proof of this is found in the case of alkalies (lithium, sodium, potassium, caesium, rubidium). The spectral lines of these related elements do not in the least conform to the law above mentioned. What then causes the difference between the three above mentioned groups? Either the atoms are composed of different substances or they are not similar in form.

Let us continue to consider the substance as identical, but vary the form. Instead of a sphere, let us choose first a prolate (that is, almost oval) spheroid, such as is generated geometrically when an ellipse rotates about its long

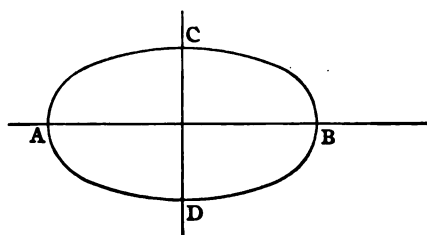


Fig. 1. This ellipse revolving about the axis A B generates a prolate spheroid, revolving about the axis C D an oblate spheroid.

axis. It follows from the mathematical theory that the spectral lines of such an ellipsoid depend on three numbers, that is they can be grouped according to three different principles. These numbers become the roots of certain transcendental equations, and are computed from the lengths of the axes of the ellipsoid, its density and elasticity—a calculation whose actual performance, to be sure, seems hardly practicable.

The first of these three numbers defines a group of related lines, a so-called series; a certain range of such series corresponds to the different possible values of the first number. The second number determines in each series a smaller group of lines, and the third points out in

each subordinate group one single individual line. The way in which the third number enters into the calculation, teaches us further that the reciprocal values of the wave lengths for the single lines of the above mentioned subdivisions, form constant differences among themselves, i. e., differences which depend solely upon the nature of the given ellipsoid. By this means we obtain a characteristic type of line distribution, a type which is familiar to us from the catalogues of spectral lines, and which is to be found only in the case of the above mentioned alkalies. For these Rydberg, Kayser and Runge have derived by observation certain conformities which essentially coincide with those for the spectrum of a prolate spheroid as above described, while the formulas obtained from experiments harmonize according to the type with those obtained from mathematical theory. The latter are derived from the representation of the solutions of linear differential equations by means of semi-convergent series. An actual calculation in all details is of course not possible as yet, because of the complexity of the formulas. The alkali atoms (Li, Na, K, Cs, Rh), we may inversely conclude, have the form of prolate spheroids, and for each single element the axis lengths of these ellipsoids are accurately defined; for different elements of this alkali group the ellipsoids in question are not similar to each other.*

An essentially different line distribution is produced by the so-called oblate spheroid. In this case, too, there are the same number of groups, series and subdivisions, but the law of constant differences becomes less universally valid; the roots of the transcendental equations become in

* The mathematical deduction of this and the following results have been published in two essays in the reports of the *k. bayer. Akademie der Wissenschaften*, Bd. 31-33 (1901-1903). The deduction of the more exact formulas by the aid of the semi-convergent series, as well as the consideration of the vibrations of rings and rolls (*Wülste*) may be found in a forthcoming sequel to those essays.

part imaginary; consequently some groups consist only of one single strong line, and others of a limited number. The more oblate the spheroid, the more prominent is the type. Experimentally the latter is known by the grouping of lines in the spectrum of the metals, gold, silver and copper. Hydrogen too, which in its reactions shows many analogies to metals, belongs to the same class, inasmuch as a thin round plate conceived as an extremely oblate spheroid, shows a spectrum of the same type as hydrogen.

In the third place we will consider the general ellipsoid of three axes, i. e., we will try to find the wave lengths of the light emitted by such an ellipsoid in an incandescent condition. The corresponding lines of the spectrum in this case likewise depend on three numbers, which are determined by transcendental equations and each of which can pass through a certain series of separate values. But these lines are not arranged in series and groups as in the two other instances, but instead are distributed over the whole spectrum. A series can be constructed only when the form of the ellipsoid approaches very near to that of an ellipsoid of revolution. This indeed can be discovered experimentally in the spectrum of the alkaline earths (barium, strontium, calcium and magnesium), i. e., those elements that in their chemical properties stand between alkalis and real metals. The same is true of zinc, cadmium and mercury. The former resemble more closely the prolate ellipsoid; the latter, the oblate.

If we proceed from a spheroid and think of it as varying so gradually that it becomes a general ellipsoid, then the lines of the spectrum will steadily change with the form of the atom, and it follows from the mathematical propositions that out of each individual line eight new ones will appear. Such a splitting of the lines, on the other hand, can be obtained experimentally by bringing the luminous atoms of the element under consideration between the

poles of a strong magnet; this is the well-known Zeeman phenomenon. Between the poles of a magnet the luminiferous ether is in a state of polarization, i. e., in a state of partial tension; but the mathematical treatment of the light-vibrations in polarized ether is the same for a spheroid as that of a general ellipsoid in unpolarized ether. Therefore we can make the inverse statement, viz., that the so-called Zeeman effect, or the splitting of the spectral lines by means of a magnet, is a consequence of the polarization of the ether and takes place as if the atom were correspondingly altered by compression.



Fig. 2. The circle revolving about the axis A B generates the ordinary ring.

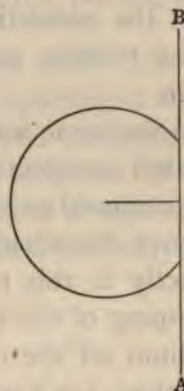


Fig. 3. This circle revolving about the axis A B generates the roll (*Wulst*).

Finally we will take a ring as a possible form of an atom for the basis of mathematical analysis, i. e., such a body as is generated when a circle revolves around an axis which does not pass through its center. We can distinguish two cases:

1. In which the axis does not intersect the rotating circle; the ring is open in the center and has the form of a round wire or rod bent into a circle, in short of a finger ring (Fig. 2);
2. In which the axis intersects the rotating circle; the ring is closed in the center; we speak then of a roll

(*Wulst*); the form is somewhat similar to that of an orange or an apple (Fig. 3).

The vibration problem may still be solved with regard to the ring form although the difficulties are increased; but with it closes the number of forms that can be successfully treated by mathematical methods.

The spectral lines of a luminous ring are dependent on four numbers, each of which must pass through a series of values, and indeed we can most simply get a clear idea of the type of spectrum by repeating several times consecutively the spectrum of a prolate spheroid, while at the same time of course, always shifting somewhat the relative position of the lines in the auxiliary spectrum.

If in the same way the spectrum of an oblate spheroid is repeated consecutively, such a system of spectral lines will be produced as would belong to a luminous roll of the kind above described.

Exactly in this manner Paschen and Runge describe the grouping of the spectral lines in the spectra of oxygen and helium on the one hand, and sulphur and selenium on the other; for according to their view the oxygen spectrum is produced when that of an alkaline metal is shifted repeatedly upon itself; and the sulphur spectrum, when certain groups of lines in the oxygen spectrum are replaced by single heavy lines. So we come to the conclusion that the oxygen atoms are probably in the form of a ring, and the sulphur atoms in the form of a roll.

There is a great fascination in following up the deductions which are connected with these notions and results. First of all it is noteworthy that the *chemical relation* of the elements seems to be dependent on the form of their atoms. Together with attraction and repulsion, the geometrical form of atoms must be considered in relation to the possibility and stability of a combination. So, for

instance, oxides of metals will result when the ellipsoidal metal atoms are deposited in the opening of the oxygen ring and close it up.

The water molecule consists of one atom of oxygen and two atoms of hydrogen; the latter we already know

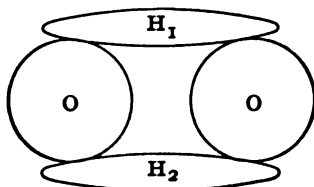


Fig. 4. Cross-section of a water molecule H^2O (one ring cut in two places O, O, and two oblate spheroids, H_1 , H_2).

to be thin round plates. Hence when such thin plates take their places above and below the opening of the ring as it lies in a horizontal position, a water molecule is the result. Analogous to this is the construction of a sulphurated hydrogen molecule, for the roll of a sulphur atom exhibits a depression above and below in which a hydrogen atom can fit itself.

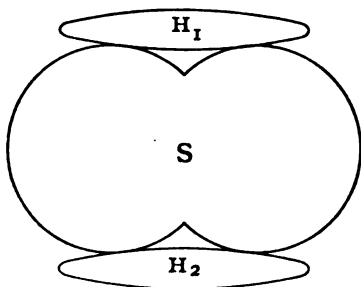


Fig. 5. Cross-section of a molecule of sulphurated hydrogen, H^2S (one roll S, and two oblate spheroids, H_1 , H_2).

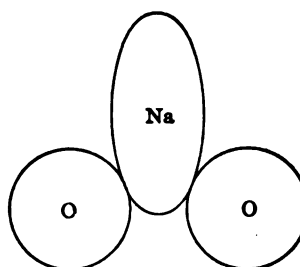


Fig. 6. Cross-section of a molecule of Na O (one ring cut in two places, O, O, and one prolate spheroid, Na).

Now the hydrogen atom may be replaced in every case by an ellipsoidal metal or alkali atom, which substitution would produce hydroxides and oxides, or on the other hand, metallic sulphides (for instance H^2S as shown in Fig. 5). But replacing one of the hydrogen atoms by a

sodium atom, there is no room left for a second sodium atom; consequently an oxygen ring can be combined with one sodium atom only (Fig. 6), and so one sodium (or alkali) atom is able to replace two hydrogen atoms. Under favorable conditions higher degrees of oxidation are formed while oxygen atoms again fix themselves upon the two metal atoms which then in turn offer free cavities for the union with still other metallic atoms.

According to this view, so-called atomicity is dependent on the form of the atom. Atomicity with reference to hydrogen (more generally with reference to ellipsoids) must be distinguished from atomicity with reference to oxygen (more generally with reference to rings). The former is equal to the number of the cavities of the atoms where an ellipsoidal atom may be joined, and the latter is equal to the number of prominences or convexities to which a ring can be affixed.

It would be of especial interest to study the chemistry of carbon combinations from this point of view. First would arise the question of the form of a carbon atom. Its spectrum throughout its entire extent is traversed almost uniformly by spectral lines, whence it is impossible to establish empirically any conformity to law and the mathematical treatment can therefore be of no service. Hence the question must be reversed, and the form of the carbon atom must be determined from the chemical nature of carbon combinations with other elements. This is a path which, as far as carbon is concerned, chemists have pursued under the leadership of Le Bel, van't Hoff and Werner, although with the other elements (with the exception of nitrogen) the question of atomic forms has not heretofore been raised. By this means organic chemistry has succeeded in essentially facilitating clearness of order and distinction in the endless variety of carbon combinations.

Different propositions have been made to so determine the form of the carbon atom that an explanation of the so-called isomeric combinations might be especially derived from it. Whether these propositions are consistent with the notion of atomicity here developed, whether they are not rather obliged to be modified or supplemented, cannot be discussed here. The question becomes intricate in the first place from the fact that the modern stereochemistry, the task of which is to demonstrate the construction of a molecule from its atoms in space, is satisfied by regarding whole groups of combined atoms as new units. When it shall come to pass that the atomic form of the carbon atoms is not used only as a symbol for the systematic arrangement of observations, but that the molecules of organic chemistry are really constructed in their spatial relations out of the form of all utilized atoms, then it will be necessary again to dissolve into its atoms every group of atoms in a molecule, which forms a definite smaller group. By this means the problem becomes unusually involved and we must be content to simply indicate it here.

By such a construction of the molecule a well-defined location within it is assigned to each atom, although it may retain enough freedom to be able to vibrate in this place around a particular point of equilibrium. We must, however, disregard the widely circulated notion that the individual atoms of a molecule describe definite paths around particular centers according to which each molecule would represent a miniature planetary system. This notion has been invented to justify the actual existence of an "internal energy" of the molecule from a mechanical point of view. This internal energy according to the theory here submitted, consists in the internal vibrations of the atoms which serve only in part as outward radiating beams of light, while others make their influence felt

as electrical or magnetic radiation, and at the same time repelling or attracting, so that they have an essential influence on all reciprocal action of atoms. Inasmuch as we treat of the so-called individual vibrations, i. e., of such as are transmitted without any discontinuity from the inside of the atom outwards to the luminiferous ether, the mathematical treatment teaches us that they can only spread simultaneously from the inside outward, and from the outside inward, and that whatever internal energy is lost will always be replaced from without, the luminiferous ether restoring this energy spontaneously. While this exchange of vibrations usually is not noticeable in most atoms under ordinary conditions and must first be aroused by warmth or by electrical energy from without, in the case of other elements (as radium, thorium, etc.) this exchange seems to proceed with extraordinary activity under customary conditions.

In another way the so-called electron theory undertakes to account for the internal energy of molecules. This takes for granted that a large number of electrons are bound up with every material atom; these electrons themselves are neither matter nor luminiferous ether, but a third something—electricity. This notion in addition to the laws of the transposition of ions has arisen from the practice of electrolysis and is based especially upon the remarkable phenomena of radiation displayed in the inside of Geisler tubes, particularly on the observation of the cathode rays. Often the electrons are looked upon directly as the ultimate atoms (*Uratome*) of which matter is essentially composed, the electrical forces dissipating atoms into these ultimate atoms whose paths then become the cathode rays. The lines of the spectrum are thus said to be generated by periodical vibrations of those electrons around certain points of equilibrium, while according to other views each electron has its own definite motion and

with it a definite spectrum whereby the number of lines in the spectrum would be equal to the number of electrons that are combined with the atoms of matter. At any rate a mathematical exposition of empirically determined laws in regard to the grouping of the spectral lines has never yet been attained on the basis of such hypotheses. In explanation of electrical phenomena this theory fulfills its purpose in many respects; as regards the cathode rays it does not contradict the views here submitted concerning the fixed character of atomic forms, for there is no reason why an atom of a particular form under suitable circumstances might not be separated into still smaller particles. What is really remarkable then is only the fact that the ultimate atoms can be accurately reconstructed; that after the electrical disturbance has ceased the original atom is formed again. The further pursuit of these remarks would lead too far into the theory of electricity for us to be able to engage in it now. It only remains to observe that the facts on behalf of the electron theory are also consistent with the hypothesis of atoms of definite formation. Indeed the admission that there are elastic vibrations within the atom is consistent with the notion that the atoms are in their turn composed of smaller particles which periodically change their relative positions by vibrations.

Our investigations have brought us to the point where the problem of the qualitative distinction between chemical elements is reduced to a mathematical problem of form and number in a series of instances. The individual element is characterized by the lengths of the three axes of the ellipsoid which represents the atom, or by the numbers which define the size and form of a ring or roll. Still unexplained, however, is the further question as to why only certain fixed groups of numbers come under consideration, only as many groups as there are different

elements with ellipsoidal or ring-shaped atoms. Why can we not choose these axis lengths and other determining quantities at will, and then assign to them the corresponding elements? Or in short, why is there only a limited number of elements? Why are the intervening links lacking?

Natural forces must exist which are still unknown to us and which operated decisively in the construction of atoms, perhaps are still operating uninterruptedly to-day, to preserve the atoms in their permanent forms or perhaps to prevent possible deflections and variations. This is quite analogous to that other question why only a definite limited number of living organisms exist or are capable of existing. We know that the struggle for existence and the survival of the fittest exercised a conspicuous influence on the formation and preservation of organisms; may not analogous considerations also govern inorganic nature? May not the existing elements have been forming themselves in preference to other eventual possibilities, just because they were best suited to their available external conditions?

These are questions which at present we can scarcely clothe in a mathematical garb. Much less are we able to furnish a solution until we succeed in so shifting the borderline of our understanding as to reduce the qualitative attributes of matter to quantitative differentiations. We may only trust that the future will dissolve and clear away the doubts that still remain.

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MANIFESTATIONS OF THE ETHER.

THE purpose of this article is to present to the non-technical reader a very brief review of modern ideas concerning the universal ether and some of its manifestations in the material world around us.

A few of the wise philosophers of olden times dimly imagined that there might be such a medium as the ether, yet little more than a century has elapsed since its existence was first seriously considered or admitted by a few advanced investigators, and even then only to accommodate and establish the undulatory theory of light. It is now recognized not only as the vehicle of light, heat and other radiant forces, but it is accepted by many scientists as the ultimate basis of the material universe.

This sweeping conception points to the absolutely immaterial origin of matter, and to its actual creation by superphysical means from this profoundly wonderful, unlimited, intangible and almost inconceivable entity,—the universal ether.

The phenomenon of light is one of its most familiar manifestations. We are accustomed to consider light as the antithesis of darkness, and the term is generally used to indicate the sensation produced in our organs of vision by ether waves of certain well-known frequencies and amplitudes.

All ether waves, however, which have the same physical characteristics as those which produce for us the vis-

ible spectrum may be classed with light waves, but it has become customary to generalize them under the common term of "rays," as for example, thermal or heat rays, ultra-violet or chemical rays, X-rays and so forth. There are other phenomena which have been also generalized under the same term although they are not produced by ether waves, but by the rapid flight of minute particles of electrified matter, or of electrons. In this category belong cathode and canal rays, also the alpha and beta rays which emanate from radium.

Etheric waves include a vast field of frequencies, beginning we know not how far down the scale, but first recognized in the electric waves of low frequency and great amplitude which were so brilliantly predicated by Maxwell in 1864, and afterwards discovered and demonstrated with exquisite skill by Hertz in 1888. Then sweeping upwards with ever increasing frequency and diminishing amplitude through a great unknown region, these ethereal undulations are next manifested in the heat spectrum which was so ingeniously explored and mapped out by Langley and other investigators.

Then passing from the heat rays, we see them dimly dawning in the first red beams of visible light, and now brightening and shining through all the rainbow hues of the visible spectrum until at length they fade into violet twilight and sink again into darkness. Yet not lost, but next manifested in the ultra-violet or chemical spectrum, and then through another vast and unexplored expanse to the region of the so-called X rays, and presumably onward from thence towards a vanishing point of infinite frequency and zero amplitude.

Considering the extent of the visible spectrum as one octave in this vast scale of etheric notation the invisible heat spectrum may be said to extend about five octaves below it. Still lower in the scale there are many octaves

of the vast unknown spectrum which exists between the longest heat waves and the shortest electric waves that are used in wireless telegraphy, etc. Above the single octave of visible light waves are found about two octaves of invisible ultra-violet or actinic waves. Then come seven or eight octaves of another great unexplored and unknown spectrum beyond which appear the X rays of varying qualities and probably the gamma rays of radium. These are believed to be manifestations of ethereal pulses having the highest frequency and the shortest amplitude thus far discovered, for of the region beyond nothing is yet known.

It is doubtful if we shall ever be able to comprehend the full compass of this vast and magnificent ethereal scale owing to the limitations of our perceptive powers, but enough of it has been revealed and understood to sharpen our desires for a broader knowledge and a clearer insight, and just as Maxwell was enabled to predict, and Hertz to produce and demonstrate the low frequency electric waves, and as Roentgen was led to discover and make visible the high frequency X rays, so will other investigators in this infinite field of research be inspired to unfold and bring to light many new manifestations that are now hidden from our view.

The tendencies of ignorance and barbarism are to scatter and divide, but the trend of advancing knowledge and civilization is to consolidate and unify. The early promptings of man's religious inclinations persuaded him to imagine that each object in nature was controlled by its own peculiar deity. He had "gods many and lords many" but with the development of higher mental qualifications, he became satisfied to believe in the existence and government of one God. So also many of the old philosophers believed in a multitude of various "virtues" or "emanations," each of which was supposed to be the origin of one particular natural phenomenon. Thus there was one virtue or ema-

nation that produced light, another heat, another magnetism, and so forth. In striking contrast to this heterogeneous multiplicity of scattered causes, let us consider the grand simplicity of the natural forces when demonstrated to us as only the varied but consistent manifestations of one universal medium. And yet who can feel surprise that these older ideas should have been conceived, for they were apparently based on principles of fact and common sense. How differently, for example, do light and heat appeal to our sense perceptions, and who would naturally suppose that each of these sensations is caused by the same order of ethereal undulations? So also with the electric waves of Maxwell and Hertz, and Roentgen's X rays, to all of which our senses are impassive and which are only revealed to us by their secondary effects. How could any superficial observation of these phenomena inform us that they are all due to a series of ethereal waves which differ only in magnitude and frequency from other waves that convey to us the sensations of light or of heat?

Having thus very briefly considered some of the natural forces as manifestations of the ether, let us now turn our attention to tangible matter.

Within comparatively recent times the indestructibility of matter was hardly questioned, and the absolute permanence and indivisibility of the material atom was generally acknowledged. New elements were being discovered by the chemist and we were growing somewhat confused by the ever increasing number of presumably unalterable and eternally permanent elementary substances. For some obscure reason the scientific mind often rebelled, at least inwardly if not openly, against this ever growing complicity in nature and yearned for basic simplicity and unification. How pleasing and satisfying therefore is the prospect of solving this perplexing question by the revelation of a material monism that is based upon a rational

interpretation of indisputable facts, and which appeals with equal force to both reason and idealism.

The so-called elementary substances were long ago separated into their constituent molecules and the molecules were divided into atoms, but here we came to a standstill until the electronic hypothesis suggested the subdivision of the atom into its ultimate particles. These transcendently minute entities which Dr. Johnstone Stoney very aptly termed "electrons" have been most carefully and diligently studied, but it is possible that their structural mechanism may never be clearly determined and understood. It is however probable that they are simply differentiated ether whirls or vortices that are endowed with intense activities of unknown, perhaps unknowable, origin. The material atom, far removed from individual inspection by reason of its infinitesimal size, is yet of colossal proportions when compared with the inconceivably minute ethereal monads which are believed to perform their orderly planetary evolutions within its boundaries, and the suggestion is offered that it is their relative numbers and their respective groupings and velocities, together with the scope and general characteristics of their orbits, that individualizes their containing atom, which in turn determines the physical qualities of the so-called elementary substance of which it may form a part.

The interatomic spaces between these electrons may be comparable to planetary spaces, and it is at least conceivable that the mechanics of the visible universe may be typical of atomic structure, making the infinitely great emblematical of the infinitely small, and thus, quoting the words of Professor Serviss, "Starting from the smallest things of which we can have any knowledge and rising to the greatest things which the universe presents, we may find everywhere a single plan running through them all,

the stupendous star cluster showing us an image of the infinitesimal atom."

According to this hypothesis, therefore, the entire material cosmos may be considered as simply a manifestation of the ether. Ether points endowed superphysically with various activities appearing as electrons, systems of electrons of more or less complexity, forming atoms, atoms combining into molecules, and molecules building up matter in all its various physical forms and countless combinations. So also, on the other hand, motions and strains communicated to the surrounding ether by atomic or interatomic activities are manifested in the various natural forces, which in their turn again affect other material atoms or their constituent parts. The unending cycles of cause and effect are thus continued, and we have found that although when at rest and under no strain, the ether appears to us as nothing, yet when endowed with motion and under strain it becomes everything.

All substantial matter and all intangible forces, all things in fact of a physical character that our senses can perceive or our minds can contemplate are resolvable into manifestations of this wonderful medium. Thus far has science seemingly traced back matter and energy to their sources: ether and motion, but here the limit of human understanding is reached. The First Great Cause of physical phenomena is still beyond us and we are again confronted with the time-worn question, "Canst thou by searching find out God?"

These far-reaching conceptions which are alike attractive in their beautiful simplicity and their mysterious depth, point to the possible explanation of some hitherto troublesome problems. For example, they entirely dispose of that logical absurdity the solid indivisible and indestructible atom, and at the same time illustrate in a rational manner how the most minute of material entities

may have a conceivable origin. They also throw some light on the mysterious force of gravitation, resolving it into an ether strain dependent on the interrelation between the spinning systems of ethereal monads and their containing medium.

The activities of these cycling electrons being in general ungoverned by known physical laws would account for the apparently unchangeable nature of so-called elementary bodies. Yet we know that at least some of these bodies are not unchangeable, for the discovery of radio-active matter has revealed the extraordinary fact that certain elements appear to undergo a continuous process of spontaneous disintegration and subsequent reconstruction into other elements of more simple physical constitution, as shown for example in the gradual evolution of helium from radium, which will be referred to again later on.

To all commonplace intents and purposes however that which is usually termed elementary matter may be considered stable, because atomic changes are so inconceivably gradual and minute that they cannot be measured, excepting by indirect and very difficult methods, and even then only in connection with a few substances which are remarkable for their high atomic weight and strong radio-active properties.

To illustrate the exceedingly minute character of these atomic changes and to show how utterly impossible it would be to detect them by any ordinary means, it is stated on good authority, that in a small scrap of radio-active material, hundreds upon hundreds of atoms may be continuously disintegrated every second and yet this process may continue in operation for hundreds and perhaps thousands of years before any appreciable change in weight could be detected. Moreover, we are assured that atomic disintegration is constantly proceeding in radium and some other substances, and it is legitimate to infer that

this action is not confined to obviously radio-active bodies, but that gradual change, at a much slower rate, is the common fate of all matter, which may therefore be broadly considered as only a transient manifestation of the ether, although it may appear to us as eternally permanent.

It is well known that the ordinary flame spectra of many elements, both solid and gaseous, may be modified or entirely changed under the influence of the electric arc or condensed electric discharge, and this fact, strengthened by additional evidence found in the spectra of the sun and of certain stars, has pointed to the resolvability of these elements into more simple constituents under certain conditions. Metals and other heavy elementary bodies however, if vaporized by intense heat, will solidify into their original form again on cooling, and elementary gases when condensed into liquids or solids by the action of extreme cold and enormous pressure, will expand again into their original state, with their qualities unchanged, when normal conditions are restored, thus indicating in each case, that the mechanism of the individual atom has not suffered any permanent disarrangement.

Neither heat nor cold nor any other physical influence, in degrees that are attainable by us, can apparently penetrate or affect these foundation stones of matter, for the forces at our command are incomparably weaker than those which control and maintain the integrity of the elemental atom.

The life history of a chemical atom may cover a period of existence which exceeds the millions and millions of centuries occupied by the birth and decay of a planetary system by as much as the latter exceeds one short moment of our existence, and it is difficult for our finite minds to form any adequate conception of these tremendous eons of duration.

Material bodies however do not consist only of aggregations of atoms, but contain also free electrons, although to what extent has never been clearly determined due to their possessing few, if any, of the physical attributes common to gross matter. There is reason to believe, however, that the apparent transit of electricity through conductors can only be effected by the migration of free electrons, and for this reason we may infer that in metals and other substances which conduct electricity freely, they must exist in vast quantities and also be in a very mobile condition. The hypothesis has indeed been advanced that the conductivity of metals may be directly proportional to the extent of the mean free path of the electrons which swarm within the interstices between their atoms. On the other hand it may be legitimate to suppose that bodies which do not normally conduct electricity contain few electrons, or rather that the electrons within their substance may be bound or fixed in a way which checks their mobility of action. The last hypothesis appears to be the more feasible because some substances which are non-conductors at ordinary temperatures acquire conducting properties when strongly heated.

It is not within the scope of this review to discuss at any length the intimate relationship which appears to exist between electrons and that *something* which is manifested to us as electricity, but it may not be out of place, to touch very briefly and superficially on this subject.

Electrons can be expelled from matter in many ways, and in every case they appear to carry with them a negative charge of electricity, leaving the substance from which they have been subtracted positively charged, but free electrons carrying positive charges have never been isolated. When matter is negatively charged it is therefore presumably due to the assimilation of free electrons. Attention may here be drawn to the anomalous fact that a so-

called positive charge of electricity is due to a deficiency of electrons, and a so-called negative charge is the result of their surplus accumulation. This reversed nomenclature, although a little unfortunate, does not affect final results in practical work, so the terms "positive" and "negative" are still commonly used in accordance with the original application given to them by Benjamin Franklin, and it is interesting to note that although he accidentally reversed his plus and minus signs, yet his so-called "single fluid" theory of electricity borders very closely upon our most recent conceptions.

Seeing that these modern views of electronic mechanism are largely due to the discovery of radio-activity, or at least that they have been greatly strengthened and reinforced thereby, a few remarks on the most important features which have led up to these profoundly interesting and important results may be acceptable.

Radio-activity was first observed as a new property of matter by Becquerel about nine years ago at the time when the then recent discovery of X rays by Roentgen had naturally stimulated scientific research. It had been generally known for some time previous to this that certain minerals possessed the property of absorbing or storing up light rays and afterwards emitting them as a phosphorescent glow visible in the dark. The fact that X rays are able to affect a photographic plate through substances that are opaque to visible light suggested the possibility of sunlight being absorbed and then emitted in some form of radiation similar to X rays. Becquerel had been experimenting along these lines and he had wrapped some sensitive photographic plates in folds of black paper and placed them in the sunshine with lumps of pitch-blende over them. The story goes that a sudden rain storm caused him to hastily bring them under cover and they were put away in a dark closet and forgotten for a day or

two. Becquerel then brought them out to expose them to sunlight once more, but thought he would first try to develop one of the plates to ascertain if the original short exposure had produced any effect. To his surprise he discovered that the lumps of pitch-blende had photographed themselves on the plate with a strength that appeared to be out of all proportion to the brief time of their exposure to sunlight. Becquerel's acute mind immediately suggested to him that some action must have taken place in the dark closet, and on repeating the experiment without any exposure to light, he found that the pitch-blende produced a photograph of itself on the sensitive plate through several folds of black paper, when kept in perfect darkness. This was certainly a wonderful clue, and it was the starting-point of a series of experiments with which the world is familiar, and which have immortalized the names of the Curies and other investigators whose labors have revealed to us the wonders of radio-activity as exhibited in radium, thorium, uranium and some other kindred substances.

Selecting radium as a representative of this class, its most interesting and important characteristics may be summarized as follows:

1. It has the property of affecting a photographic plate through certain materials which are opaque to visible light.
2. Its emanations will discharge an electrified body by ionizing the surrounding air and thus making it a conductor. This feature is so marked that it furnishes the most delicate test known for the detection of radio-activity.
3. It excites fluorescence in certain minerals, but this phenomenon is partly of a different character to the ordinary fluorescence or phosphorescence that is excited by their exposure to light rays, as will be noted later on.
4. It generates continuously an appreciable amount of heat, so that under proper conditions it will maintain a

temperature within itself two or three degrees higher than that of surrounding objects.

5. It has the property of imparting a temporary radio-activity to all substances in its neighborhood by the deposit thereon of an infinitesimally thin layer of radio-active particles derived from its emanation.

6. It has a very marked effect on living tissue, and tumors, ulcers, cancers and other malignant growths have been pacified and even cured by its application.

Dangerous burns may also be inflicted by using it indiscretely, and it is a curious fact that these effects, like burns from X rays, may not appear immediately, but may develop many days or even weeks after the application has been made.

We may now proceed to briefly consider the origin or cause of some of these extraordinary properties, drawing our information from the classical researches of Ramsay, Rutherford, Soddy, and a few other scientists who have given special and untiring attention to these matters.

Referring to previous remarks on the mechanism of the atom, it is conceivable that certain conditions may occur to disturb the equilibrium of the velocities and orbits of an electronic system constituting an individual atom, in which case it may become unstable and explode or fly to pieces, either partially or entirely.

The atomic weight of radium is believed to be about 225, and when one of these heavy atoms is disintegrated, a train of results will follow which point to a partial explanation of its remarkable properties.

1. Material atoms that have been commonly termed "alpha" rays or particles are projected from the disintegrated parent atom with varying velocities up to a maximum of about 20,000 miles per second. These particles are not radio-active; they have about twice the atomic weight of hydrogen atoms and they are believed to be in



fact atoms of helium. Although they are projected with a speed that far exceeds that of any other known form of moving matter, their velocity is slow when compared with that of free electrons, and they possess but slight penetrating power, being unable to pass through even a thin piece of paper. When they impinge on certain materials, as for example, fluorescent zinc sulphide, they produce little flashes of light. The scintillations thus produced are so numerous and minute that in the aggregate they present a faint phosphorescent glow to the unaided eye. On examination, however, with a magnifying glass of moderate power, say about twenty diameters, individual scintillations become visible and appear as a multitude of constantly changing and twinkling points of light in a dark or slightly luminous field. Sir William Crookes was the first to discover this beautiful phenomenon and he applied it to interesting service in his well-known spinthariscopes.

2. The residuum of the parent atom after its primary disintegration and the projection of "alpha" particles, assumes the form of an intensely radio-active emanation or heavy vapor, which continues to spontaneously decompose, ejecting more "alpha" particles, and breaking up rapidly in successive stages into other more or less radio-active products, each one differing in some degree from its predecessor.

3. Free electrons are also expelled from these products, which are endowed with enormous velocities varying from 60,000 to 175,000 miles per second, thus, in their most rapid flight closely approximating the speed of light rays. These electrons always carry a negative charge of electricity and they are commonly termed "beta" rays. They were foreshadowed in Faraday's "radiant matter" and are believed to be identical with the cathode rays formed in a Crookes' tube. Each electron appears to possess a uniform mass of about $\frac{1}{1770}$ of a hydrogen atom and collectively

they have considerable penetrating power, their intensity being only reduced about 50 per cent. by passage through two inches of air at atmospheric pressure or $\frac{1}{50}$ of an inch of aluminum. The tremendous velocity of these "beta" rays or free electrons, and likewise that of the comparatively massive "alpha" particles points to the almost inconceivably high orbital speed of the members of the electronic systems composing the parent atoms from which they are projected when these atoms are disorganized and broken up by interior disturbances.

4. Incidental with the expulsion of "alpha" particles and "beta" rays, ethereal pulses are propagated with the velocity of light rays and possessing strong penetrating power. These ethereal pulses are termed "gamma" rays and they are probably produced by the impact of the "beta" rays against the solid material of the radium compound in the same manner as X rays are evolved by the impact of cathode rays against the platinum target of a Crookes' tube. Their resemblance to X rays is further demonstrated by their power to produce fluorescence in platino-barium cyanide, a screen of which material gave to Roentgen his first accidental clue to the discovery of X rays.

5. After undergoing sundry transformations as already noted, with the evolution of "alpha" particles, free electrons, and "gamma" rays, the material is probably reduced eventually to some stable substance or substances, and the universal presence of lead in ores containing radium has suggested that this metal may be at least one of the final products.

Radio-active effects may therefore be classified under several different headings such as, for example, thermal, luminous, chemical, electrical, etc., thus corresponding with the manifestations of ethereal waves before referred to, although not confined within these limits.

To sum the matter up, these effects are believed to be the result of a spontaneous disintegration or breaking up of heavy and complex atomic structures into lighter and more simple atoms and free electrons, accompanied with the evolution of energy which, considering the small mass of matter involved, has been estimated by Rutherford to be at least a million times greater than that developed by the most violent chemical reaction; comparatively stable matter being eventually formed as a last residue.

It is not consistent with sound and progressive thought to believe that present views are infallibly correct. They may indeed be considered extremely crude in some respects and will doubtless be subject to many changes in the future. We trust, however, that our progress towards a realization of ultimate truth will be hastened, and that we may be led onwards and upwards to clearer conceptions and more intimate knowledge of the mechanism of matter and the manifestations of the universal ether.

I may fittingly conclude by quoting the words of Lord Kelvin, who for more than half a century has devoted much time and thought to the solution of these difficult problems. He says: "Overpoweringly strong proofs of intelligent and benevolent design lie around us, and if ever perplexities—whether metaphysical or scientific—turn us away from them for a time, they come back upon us with irresistible power, showing to us the influence of a free will through nature and teaching us that all things depend on one Everlasting Creator and Ruler."

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HEREDITY, AND THE ORIGIN OF SPECIES.*

THE surface of the earth is inhabited to-day by hundreds of thousands of forms of life, which upon analysis are found to be separable into groups or species, with well-marked and characteristic attributes, which may be transmitted from generation to generation. The strata beneath the surface are found to contain the remains of thousands of other forms, now extinct, but which show certain general relationships to the existing organisms. If we piece together the actual records, and take the backward bearing of our information, we arrive at a period sometime within the last six hundred thousand centuries, when living matter was more indeterminate in the forms which it assumed, and was, perhaps, quite unlike any protoplasm we meet at the present time.

From this primitive substance series of organisms have been produced, which, in the successive stages of the earth's history show an increasing complexity as the present epoch is approached, and which embrace more numerous forms with the advance of time.

In this upward movement, this evolution from the simple to the complex, in the production of many from few, it is not to be taken for granted that protoplasm has been a perfect automaton, and that it has nothing but successes scored to its credit in the ever-changing conditions it has

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met since its beginning. On the contrary the succession of its forms is a most devious one, and by no means easily traced. Phylogenetic systems are made up chiefly of allowable suppositions, and it is altogether probable that we do not know more than a fraction of the course of the zigzag, halting, and at times, receding steps followed by living matter in its development into existing types.

Thus the mosses are seen to have reached the ultimate development allowable by their morphological character, and hence are incapable of any movement which will produce higher or better organized types. Accordingly we may assume that their existence as a constituent of the flora seems to be doomed to a diminishing importance, if not final extinction. The fern-like plants are also examples of a great phylum of the vegetable kingdom which, in the Carboniferous period, being most suitable for the conditions present, constituted the prevailing type of vegetation, making up perhaps as much as three-fourths of the plant-covering of the land. Their organization is one which promises nothing of advantage vegetatively and reproductively, and we are now at a time when we see them slowly but inexorably, being supplanted by seed-producing forms.

With the advance and retreat of the ice-sheets, the upheaval and submersion of land areas, and other great alterations in the earth's surface the hosts of plants have marched and countermarched across the face of the world, now losing thousands of species, the remains of which we exhume from ancient battlefields; now entering upon new possessions and increasing the numbers of species and forms by originating new types, which survived or perished according to their fitness or unfitness. In the interpretation of the traces of these major movements of living forms great care must be exercised in distinguishing the essentially different factors affecting the distribution of

plants and animals. It is as if two games of checkers were being played on an enlarged board at the same time, the moves of each player being governed by those of his opponent and interfered with by those of his neighbor, and the two players on one side of the board by no means advance, guard and retreat in parallel fashion, while their losses and gains may be wholly disproportionate. With regard to the application of this warning note it is to be said that the "naturalists," as some zoologists term themselves, having made the greatest number of essays to offer a universal interpretation of the problems of distribution are to be credited with the greatest number of defenceless assumptions. In all developmental and evolutionary researches too much emphasis can not be laid upon the basal fact that the physiological and morphological nature of the two great classes of living things are so widely divergent, that the derivation of universal biological principles from their apparently concurrent behavior, must be made with the greatest caution.

Let us pass at once to the basic problems of life, those of the origin of characters and their inheritance, by which new species arise. Very naturally the first statement advanced was a purely theological one, that species were created directly, and that we need not expect to find an explanation in natural causes.

Of the hypotheses that may be taken more seriously, one that has even lately been regarded with much favor, predicates that organisms undergo transformations, or alterations by adaptive changes in their organs and entailed functions, as a direct reaction to environmental factors, and the altered features becoming fixed and inheritable, the organism receives a lasting imprint from its habitat. Migration to new areas, or changed climatic conditions might give opportunity for new stimuli and different reactions which might, or might not, affect those pre-

viously made. We need not, at this time go into the intricacies of the arguments that cluster about this main thesis, or weigh the evidence that is drawn from the presence of useless, vestigial, and useful characters in various organisms.

Popular belief in the influence of environment and the inheritance of acquired characters finds its commonest expression in "that plants have been changed by cultivation." Domesticated races are spoken of as "garden forms" by botanists and horticulturists, with the implication that they are specialized types resulting from the effects of tillage. Now so far as actual cultivation is concerned, this assumption is without foundation, since at the present time no evidence exists to show that the farm, garden or nursery has ever produced alterations which were strictly and continuously inheritable, or were present, except under environmental conditions similar to those by which the alterations were produced, although vague statements and erroneous generalizations to the contrary are current. It is true of course that structural and physiological changes may be induced in a strain of plants in any generation, which may persist in a share to the second, or even in some degree to a third, but no longer. Some very important operations of the market gardener and the farmer are dependent upon this fact.

The possibility that permanent changes might be induced is by no means to be denied, and it is a fair subject for investigation. Actual evidence is to be obtained only by observations of breadth under guarded conditions. Until this is at hand all affirmative conclusions can be but inferential and suggestive.

Vicinism, the somatic multiplication of bud-sports and extreme variants from a fluctuating series, and the confusion of closely related elementary species form the basis for the greater number of mistaken assertions as to

the effects of cultivation. It is obviously necessary to examine all facts bearing upon the lineage of supposedly new forms, with the greatest care before their aspect, or behavior may be taken as evidence upon phylogenetic problems.

The theory of natural selection of an intra-specific application, as one of which new forms might arise, is so well known that we need not particularize in defining its ramifications. Briefly, it is assumed that as the whole mass of individuals comprised in a species is in a constant state of variation the individuals which show features even the most slightly better adapted to the environment, survive while the less fit perish. Thus by infinitely small changes during each generation a species moves away from the ancestral type in one or more directions until in the course of thousands of years the differences become so great as to be appreciable, and of a specific character, to use an arbitrary phrase. Three unsurmountable objections to the acceptance of this method as universal present themselves. First, the fluctuations exhibited by the individuals comprised in a species do not in any known instance transgress definite measurable limits, and do not depart from an ascertainable norm or average. Secondly, the gradual transition of individuals from one type to another, that is intergrading forms, demanded by this theory, are not found among plants, and thirdly, although we have preserved specimens and records of several species which cover their history for many thousands of years, yet such gradual transformations are not observable. Lastly it is to be said that it is extremely doubtful if the earth is old enough to have permitted the development of the great number of organisms which inhabit it, by this method.

A secondary idea that has been formulated in connection with this subject is that of orthogenesis, by which the organism evolves rudimentary structures purely as a result of internal forces, and initially without reference to util-

ity, or to environment. These rudimentary organs may, in the course of generations wax in size, undergo increasing differentiation of structure, perhaps finally becoming sub-functional or even fully functional, although nascent organs are not always supposed to attain this useful end. In support of this theory it has been pointed out that plants and animals show many structures, which so far as our understanding of them goes, are wholly without part in the life of the organism. The present development of plant morphology, however, is one which is carrying us farther and farther away from the conception of such pre-functional formation of organs, as the whole tendency of modern investigation is to place the morphogenic processes upon a physiological basis. On the other hand the argument that the variations of the organisms are "determinate," and are governed by the morphological possibilities is one which surely holds for any method of phylogenetic procedure. Thus it needs but the briefest common-sense consideration to show that any given type of leaf or flower, could not possibly vary toward all other types, but only in the direction of certain forms not too widely different.

A more explicit statement may prevent a misconception. It has been held by some writers that variations and mutations, theoretically follow those already made, as a projection of them, or a continuation, which carries the organs concerned, successively and ever nearer some ideal form or type. This is determinate variation in its strictest sense. On the other hand, it is argued that from any given stage in its development an organ may vary or mutate in any direction limited of course by its morphological possibilities, and such alteration may lead the structures concerned in any given course from that previously pursued. It need only be said that to the experimenter the latter view seems to be the more fully justifiable by the facts observed in mutations.

Of the many other phases of the existence, and distribution of organisms, that have been considered in a controversial way to prove this, or that, hypothesis it must be ceded that in this discussion of the effect of isolation upon the origin and preservation of forms, the evidence adduced, so far as plants are concerned does not especially favor any of the suppositions discussed previously. In like manner the bogie of the effects of close- and cross-breeding is used in the most reckless manner to support the most diverse generalizations. Until investigated with the exactness demanded by modern technique, and by the most approved methods with material of undoubted pedigree, we may well consider close- and cross-fertilization as operations the value of which is yet to be estimated. Nearly all of the available data have been obtained with domesticated races, artificially selected from what, in the natural conditions, may be the most extreme phase of a character, and far from the norm of the species in many particulars. The retrogression toward this norm may be a deterioration of the economic value of the strain, yet from the point of view of the species itself it may be a direct movement toward the average condition, in which we may not secure so much speed, beef, wool, milk, grain, or fibre, as in strains bred and selected for these features.

It is with great relief that we turn from these historical and hypothetical considerations to the authenticated facts, the interpretation of which affords some positive generalizations as to phylogenetic procedure. In other words we take up the observations by which species *have* arisen, in place of the suppositions as to how they *may have* arisen.

First, it has been known for over half a century that fixed forms, constant in inheritance and self-maintenant, therefore constituting species have resulted from hybridization. The fertilization of the egg-cell of one species by the pollen of another, often results in an interlocked and

stable combination of the characters of the parental forms in such manner as to give rise to a new type unlike either of the parents, variously intermediate and constant to the new type in succeeding generations. More than a thousand such fixed hybrids, or hybrid species are known, some of which have been formed anew experimentally and are thus beyond doubt. It is to be seen therefore that hybridization has played, and is playing, no small part in the composition of the flora of the earth, and that it must be considered as an active, and not unimportant factor in the evolution of plants.

It must be admitted at once that such fixed hybrids are exceptions to accepted principles of dominance, and of the purity of the germ-cells, as the fixed hybrids depart entirely from the Mendelian procedure. As a further complication we have in some instances a hybrid progeny comprising several fixed types, each constant to itself. The only possible explanation of such phenomena in the simpler case calls for a fusion of the germ-cells and a double longitudinal division of chromosomes.

Such splittings are qualitatively unsymmetrical, since the fixed hybrids are variously intermediate between the parents, sometimes being goneoclinic to the one furnishing the pollen, and in other cases to the one bearing the egg-cell. When it comes to the composition of a hybrid progeny which comprises several fixed types in the first generation, breeding true in succeeding generations, we can only look to the researches of Wilson and others upon the quantitative and qualitative inequality of the chromosomes to furnish us the proper clue. It is only fair to say that no investigation of such cases has yet been made. Now as to a third category in which the hybrid is polytypic in the first generation, and some or all of the types may split in the second generation into forms, which may or not be identical with the grandparents, we evidently have a com-

plex case in which the partial fusion of unequal chromosomes, with divisions of the chromosomes may operate in a manner to secure anything but purity of the germ-cells. The results of such complicated integrations and splittings are incidental to the scope of this lecture however, as we are concerned at present only in those cases in which fixed forms result from hybridization, chiefly in the first generation. So far have we advanced, however, in the study of the behavior of hybrids, that with the information obtained from them, and with the recent discoveries as to the differences of chromosomes, we may well believe that we are now at the dawn of a new day in the study of heredity and all of its associated problems, in which the greater results are to come from the proper and closer correlation of the researches of workers in all branches of natural science.

The second method by which new characters and new species have been seen to arise in the succession of generations in plants is that of discontinuous variation, or mutation. In following out the germination of hundreds of seeds in pedigreed strains of plants, a few individuals may be found in each generation, which are notably different from the type in anatomical and physiological features. These divergencies are variously heritable, constituting breaks in descent, by which, in some cases, new species originate. Such seed-sports or seed-mutants have been seen hundreds, perhaps thousands of times during the last two centuries, but it is only within the last twenty years, that their phylogenetic importance began to be appreciated. It will be of interest to this assembly to know that American botanists and horticulturists have made early observations of direct interest in this connection. Thus Dr. Arthur Hollick, while a student at Columbia University in 1879, said in writing of white varieties of colored plants: "First then, we have to consider those sports of nature where

there has been a sudden change, without any intermediate steps, from a plant with colored flowers to a pure white variety: such may be termed "negative" varieties, since their peculiarity is due rather to an absence of color, than to the presence of white. Not only does the flower show the characteristic absence of color, but the leaves, stem, and, in fact, the entire plant, are invariably of a lighter green; and if any red be normal to the stem (which is often the case), this will also be of a lighter shade. It has often been urged that these albinos are mere 'sports' of nature with nothing constant about them, . . . , and that there is nothing inherent in the constitution of the plant. Fortunately I have been able to test this, . . . and found them, . . . not only constant in their peculiarities, but also that these are bred in the plant and capable of inheritance." Three years later, about the time that De Vries began casting about to find material suitable for the demonstration of his theory of unit-characters and their saltatory action, Mr. Thomas Meehan, a horticulturist of Philadelphia, wrote as follows, in a discussion of some anomalous form of the oak: "The conclusion that I have been forced to is that the odd forms we often find in nature are not necessarily hybrids, but are as likely, if not more likely to be the outgrowth of some internal law of form with which we are as yet unacquainted. That they do not often perpetuate themselves is (*not*, plainly implied) remarkable when we remember that of thousands of seeds produced on any one tree, but a very small percentage ever gets a chance to form, and of those which do sprout, again but a small percentage survives to become bearing trees. As the number of trees reproducing the general features of the original may be as a hundred to one of the more strikingly aberrant forms, we may see that though individual instances may be common, we are never likely to meet many trees of one stamp. Once in a while an indi-

vidual tree may find itself in a situation favorable to the preservation of a number of seedlings, which might endure until again reproductive; in such cases a marked variety may originate and make its way over the earth.

"I have often thought it probable that in time a few individuals of these suddenly introduced forms might again leap into new features, and then if they should be able to sustain themselves, we should have new species quite independently of any principle of natural selection; that principle, as I understand it, being governed chiefly by 'environment.' "

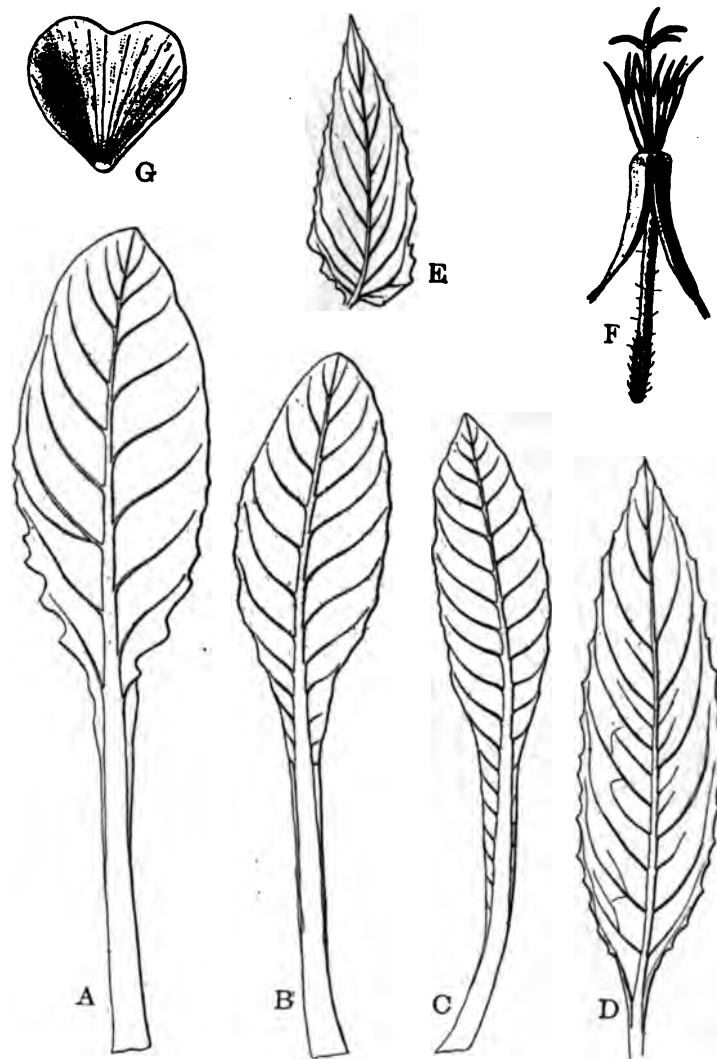
These utterances may be taken as prophetic in part, and in part as a natural expression of the inadequacy of explanations of the origin of species current at the time. Shortly afterward, Professor De Vries, impressed with the necessity for obtaining positive evidence upon the subject, began an examination of the plants in the vicinity of Amsterdam, Holland. Over a hundred species were brought into cultivation, and tested by guarded pedigree-cultures, and every precaution was taken to exclude interference of agencies which might introduce errors. It is impossible to describe the enormous amount of work entailed in such investigations, but the truly splendid results well justify the tedious care by which lines of descent were carried through successive generations for two decades without allowing a trace of doubt as to the purity of the lineage involved.

During the last four years a partial duplication and an extension of these experiments has been carried on in New York. It seems unnecessary at this late date to go into the detail of the mutations of Lamarck's evening-primrose, especially since the phenomena exhibited by them are also to be seen in many other species. By way of illustration it need only be said that this plant, as originally observed by De Vries, was found to give from two



Oenothera Lamarckiana, the parental form which is giving off many mutants. A, B, and C, leaves from rosette. D, leaf from middle of flowering stem. E, bract. F, flower with petals removed. G, petal.

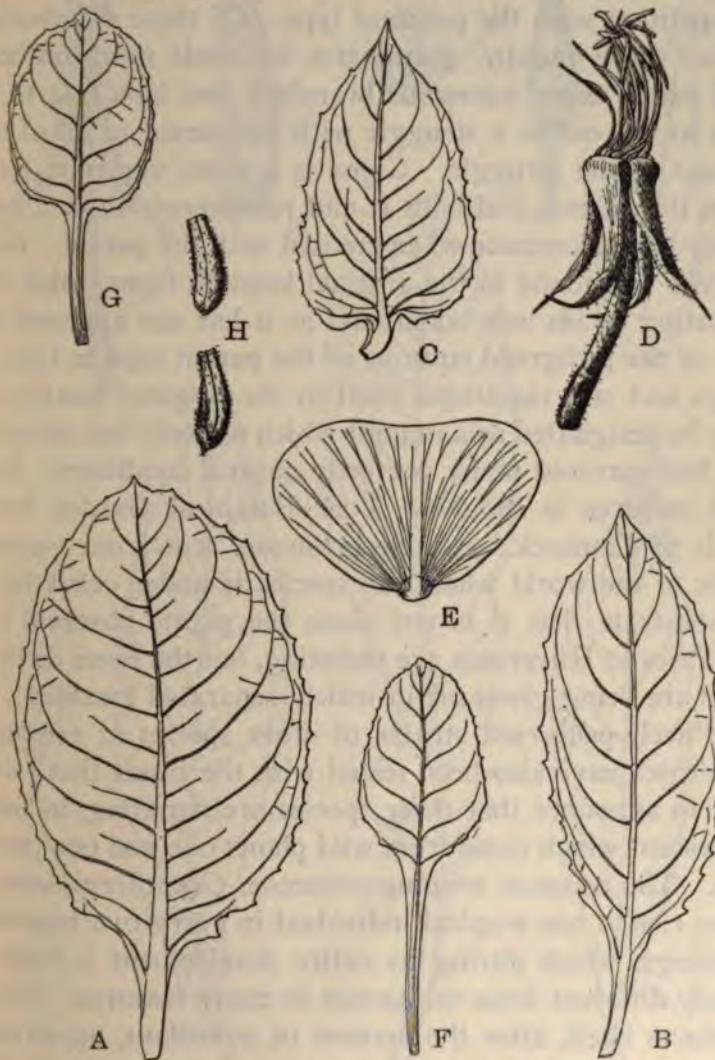
to five plantlets in every hundred which were widely divergent from the type, and could, upon maturity, be ar-



Oenothera rubrinervis, One of the Mutants of *O. Lamarckiana*. A, B, and C, leaves from rosette. D, leaf from middle of flowering stem. F, flower with petals removed. G, petal.

ranged in several groups, and in fact constituted several possible species. One, *scintillans*, was eversporting, and

continuously and consistently gave rise to a variety of forms in its progeny, which included the parent and its



Oenothera gigas, One of the Mutants of *O. Lamarckiana*. A and B, leaves from middle of main stem. C, bract. D, flower with petals removed. E, petal. F and G, leaves from the rosette. H, capsules.

mutants. Another, *lata*, was imperfect and did not mature pollen, and hence was incapable of independent existence.

Others were perfect and vigorous both vegetatively and reproductively, and have been found capable of sustaining competition with the parental type. Of these *rubrinervis* grows more rapidly, germinates its seeds more quickly, and makes more numerous branches, and bids fair to be able to win out in a struggle with the parent in all of the phases of the struggle. *Gigas* is a more vigorous form than the parent, and both it and *rubrinervis* show a tendency to predominate when crossed with the parent. *Brevistylis* was found in the original location from which the mutating strain was taken, and as it has not appeared in any of the pedigreed cultures of the parent type in twenty years and still maintains itself in the original locality, it may be designated as a mutant which not only has arrived, but has survived under perfectly natural conditions. Recent cultures in the New York Botanical Garden from seeds of Lamarck's evening-primrose, sent from various parts of the world where the species is under cultivation, demonstrate that it is not alone the plants observed by De Vries at Hilversum are mutating, but the same derivatives are being given off in widely separated localities.

Purely-pedigreed strains of other species of evening-primroses have also been tested with the result that I am able to announce that three species are mutating, in lines of descent which came from wild plants one and two years ago. The common evening-primrose, *Oenothera biennis*, gives rise to one atypical individual in every two hundred seedlings, which during its entire development is continuously different from the parent in many features. It reproduces itself, after the manner of *scintillans*, appearing to be eversporting and giving many of the parental individuals in the purely fertilized seeds. Within the last two months a single rosette representing a new and unknown type has appeared in the seed-pans appearing to be a mutant which is found not more than once in twelve or fifteen



The Common Evening-primrose (*Oenothera biennis*), which is giving off one or more mutants. A, B, C, and D, leaves of the rosette. E, leaf from middle of flowering stem. F, bract. G, bud. H, flower with petals removed. I, petal. K, capsule.



A Mutant of the Common Evening-primrose. A, A, leaves of the rosette, and from the stem. B, flower-bud. C, flower with petals removed. D, bracts. E, capsule with bract in profile. F, petals.

thousand plants. The evening-primrose of the Adirondacks and northern New England, *Oenothera cruciata*, has been found to give atypic individuals conforming to a single type, which is also represented by specimens that have been collected in a wild state, so that here also, we have the survival of a species which is still arriving in a large proportion of the progeny. The great-flowered evening-primrose, *Oenothera grandiflora* of the southern states has been grown during two generations and it also is found to give derivatives, one or more of which appear to be already represented in the flora of the region.

One of the most interesting correlations to be made from a study of the results of these observations is to be found in the parallel mutations exhibited by the several species, in apparent contradiction of the principle of radiate variation and mutation (*allseitige Mutationen*). Among these are to be mentioned the origination of a form with cruciate flowers of the same general form as the *Oenothera cruciata* of the Adirondacks, from the species known as *O. biennis* in Holland, which is not identical with any species known to grow wild in America. The same species has also been seen to give off a mutant having the character corresponding to the mutant *nanella*, coming from *Lamarckiana*, according to De Vries. Then an evening-primrose of unknown identity has been found on Long Island by Dr. Shull, far removed from the locality inhabited by any other cruciate plant, and strongly suggestive of a mutation from *biennis* or some other form native to that locality. Such facts merely show that the forms borne by nearly related species lie well within the limits of the morphological possibilities in saltations and that they may be expected to be duplicated in other observations.

Scattered through the literature of botany and horticulture of the last century are scores of records of the

sudden appearance of sports and forms of the aspect of species which fully support all of the conclusions drawn from the observations on the evening-primroses. An examination of the facts easily brought together allows us to see that certain general principles in the organization of the plant, and in its behavior in these breaks or saltations in heredity may be made out.

The first and most important of these is one which was advanced by De Vries speculatively, before he began his experiments in heredity, namely that the plant is essentially a complex group of indivisible unit-characters. These unit-characters may not always be expressed, or recognizable in external anatomical characters, since they may be in a latent condition, or totally inactive, or external taxonomic characters may really consist of several elementary qualities, but these are not shown in any intermediate stage although they may be modified within the limits of fluctuating variability.

Any plant, supposedly, includes thousands of unit-characters, and as they are essentially qualities, or capacities, they do not usually coincide with the characters ordinarily used in taxonomic descriptions. As an illustration, the phases of geotropic sensibility of an organ may be considered as a unit-character. Thus a branch is either apogeotropic, directing its tip directly upward, or it may be diageotropic placing its axis in a horizontal plane, at right angles to the action of gravitation, or it may undergo a mutation and "weep" or direct its tips directly downward. In any case, however, it possesses one of these three forms of reaction. It does not follow, however, that all branches are actually in one of these three positions, for other forces to which it reacts may operate to place the axes in various planes, and the position of the branch may express just such concurrence of elementary characters as alluded to above, or indeed the geotropic unit-character may be latent,

and the organ may respond to other forces exclusively. Similar analyses must be used in the delineation of all unit-characters, and it is obvious, without further discussion, that we will never be able to uncover, either theoretically or actually, more than a few of these indivisible units. The forms and activities by which we recognize plants must by no means be taken to be simple in their constitution unless proved to be so, and the modification of a character in hybridization and otherwise must be taken as proof that it is not an elementary feature.

In tracing the development of species it is found practicable to designate them as retrogressive when a distinct unit-capacity, or unit-character is lost or, rather, becomes latent. Thus the loss of color must be of this kind, and also the loss of geotropic reaction, while the power of forming lacinate leaves when shown by mutants from a simple-leaved type would be estimated as a progressive mutation, as the group of characters concerned belong to a more highly organized type of organ. If a white-flowered species should give rise to a form with colored flowers it might well be taken as a degressive movement, or as a retracing of a step once lost, since all flowers were in all probability originally colored. Here again the actual test is hybridization, it being accepted that the retrogressive forms of organs are recessive or latent when crossed with the parental or nearly related types.

As to latency we can only say that strains of plants do carry capacities of one kind and another for many generations without these particular forms of unit-characters showing any activity. Thus a mutant which springs from a parental type, and shows a lacinate leaf instead of the ancestral leaf, must carry the latter form in a latent condition. The latent character may be awakened from time to time, or may be entirely and permanently inactive. The most easily analyzable examples of latency are seen in

hybrids. Thus when the blue-flowered *Veronica longifolia* was crossed with a white-flowered variety derived from it, the progeny was entirely and continuously blue-flowered except for occasional bud-sports. The white-flowered condition was here very evidently in a latent condition. In other instances white-flowered forms have appeared as a recessive, forming one-fourth of the progeny. If qualities have a cytological basis, and we may certainly assume that they do, then it is not easy to speculate intelligently on the probable condition of latent characters.

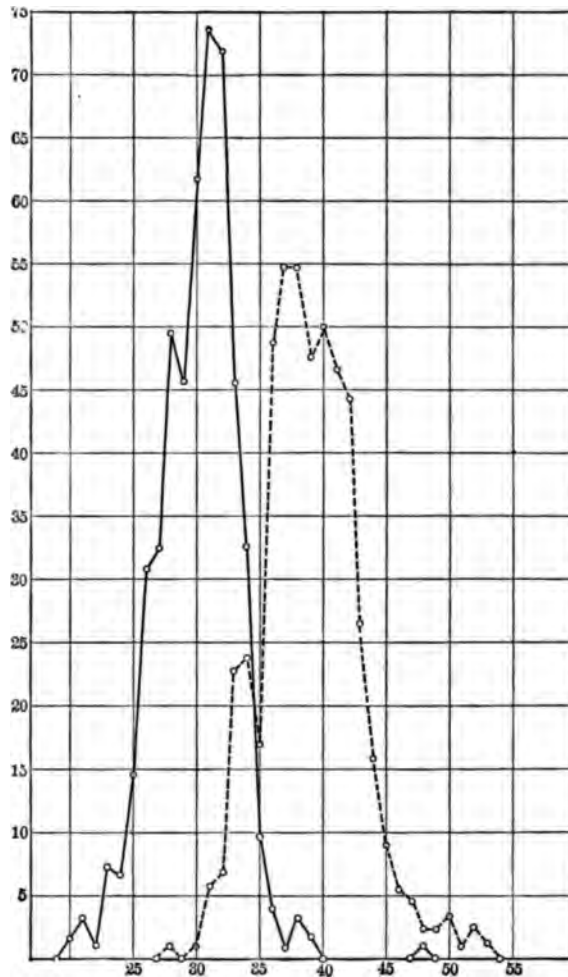
A very striking feature of mutants consists in the fact that the gross anatomical characters in which they diverge from the parent shows a much wider range of variability around its new norm, than does the homologous character in the parental type. Many observations bearing this interpretation have been on record for some time. Chas. Darwin in his *Origin of Species* noted that varieties varied more widely than the closely related species from which they were supposed to be derived, and many other observers have touched in one way or another upon the subject. Dr. Shull's recent researches upon this subject led him into the making of exact measurements, by which he also finds that the wide fluctuations of the mutant characters are accompanied by a lesser degree of correlation than prevails in the parental forms. Thus, for instance, the leaves of *rubrinervis* not only vary relatively more in width than those of the parental *Lamarckiana*, but the proportion between the width and length is not so constant as in the latter. Other organs of these and other species were subjected to exact measurements with similar results, while a large number of recent observations are known which justify the conclusions just stated. Of these the great variation of the length of the pistil in *brevistylis* in comparison, and the wide fluctuations in lacinate leaves are good examples. Many of the latter are known to be direct deriva-

tives of simple leaved ancestors, and are therefore capable of easy observation. With these facts in hand the possibility suggests itself that we might be able to distinguish between a structure recently arisen and one which was borne by a related species for thousands of years, but the exactness of such estimates is a matter of conjecture.

It seems to be taken for granted by a great number of workers interested in this subject, that species showing wide variations of the organs are the ones most likely to offer a high frequency of mutations, and my correspondents in various parts of the country are constantly calling attention to these forms under such a mistaken impression. As a matter of fact we may confidently expect that the species which show the greatest variation, or are eversporting, are the youngest.

Now having obtained the result just described we find ourselves face to face with one of the most interesting and difficult questions in heredity. If the newly arisen mutant forms are more widely variable than the older ones, how do they ultimately become narrowed? If the greater number of species originated by mutation, as we confidently believe they did, then they must have shown a much wider range of variability than they do at present; by the operation of what agency has variability been decreased, and correlations made more strict? At the present time I am compelled to say that I can not make an intelligent suggestion. Again if new characters vary widely at first, and lose this power, would it be possible to estimate the age of any given character of a species from the degree of variability? The author of the investigations just noted suggests that the best prospect for evidence of value upon this point might be obtained by a comparative statistical study of more recent types of structures in the foliar or reproductive organs, and of older forms that have come down from

the previous epoch. It certainly offers a most alluring field for research, and will doubtless soon receive attention.



Range of Variation of the Ratio of Width to Length of Leaves in the Parental *Lamarckiana* and One of Its Mutants. The dotted line shows that the range in the parent is 28-53, with a coefficient of variability of 9.53 ± 0.22 per cent., while in the mutant represented by the solid line, the range is 20-48, with a coefficient of variability of 10.30 ± 0.22 per cent.

Let us return to the question of the diversity of mutations which may ensue in any species. Theoretically

				X_2	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9		
					50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140		
					55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145		
X_1																									
-12	17						1																		1
-11	18			1																					1
-10	19																								0
-9	20			1			1	3	1																6
-8	21			1					1			1													3
-7	22					1	2																		3
-6	23							2	2	7	2		1												14
-5	24							1	2	6	2	1	2			1									15
-4	25							3	2	6	6	3	5	2			1								28
-3	26								3	5	6	11	3		1	2	1	1	1						34
-2	27								2	15	11	7	9	6	3	3				1					57
-1	28								3	4	10	8	16	5	9	1	2								58
0	29								1	2	11	19	10	3	6	5	1								58
1	30									1	13	12	10	16	10	8	1	2		1		1			75
2	31				1						2	11	18	21	6	3	1	1	1	1					66
3	32										1	8	17	20	8	7	3	3	1						68
4	33										1	9	9	7	6	3	2								37
5	34											1	6	15	5	7	1	2							37
6	35											2	3	4	13	5	2	1							30
7	36											1		1	3										5
8	37											1	1		1	2	1	2							8
9	38															2		1	2						5
10	39																2	1	1						4
11	40																		1						1
					1	2	2	4	9	17	46	64	85	100	92	80	55	24	16	7	3	0	1		614

scores of types simultaneously, while on the other hand it may originate but one aberrant form at a time. Lamarck's evening-primrose is producing a dozen, and the common species but one or possibly two, while the great-flowered species is throwing off three or four, as far as

our observations go. It will be profitable to analyze the consequences of the origination of diverse types simultaneously. In the case of *Oenothera grandiflora* it ranges from Kentucky southward to the Gulf over climatic and edaphic conditions of wide diversity. If it be assumed

		X_2	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	
			45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	
			50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	
	X_1																					
-13	24		1					1														2
-12	25			1																		1
-11	26			1	1																	2
-10	27				1	1		1														3
-9	28				1	1		1		1												4
-8	29						1	2	3	2	1											9
-7	30						1	2	2	2	3											10
-6	31						1			2	2											5
-5	32							2	2	4		2										10
-4	33					1	1	6	3	4	4	3										22
-3	34						1	1	5	8	3	3	1									22
-2	35						1	2	4	9	6	1	4	3	1		1					32
-1	36					1	1	1	2	5	10	4	5	1		1						31
0	37					1		3	11	9	11	8	5	3	1							52
1	38					1		4	3	11	10	10	3	1								49
2	39									3	7	7	8	4	1	1						31
3	40									6	4	9	6	12	3	4						44
4	41										1	8	10	5	5	1	4	1				35
5	42										2	7	9	5	3	2	1			1		30
6	43							1			1	8	4	2	2				1			19
7	44											3		6		2		1				12
8	45												1	1	1	1	2					6
9	46														1							1
10	47																		1			1
11	48															2			1			3
12	49												1					1				2
13	50												1									1
			1	1	2	2	6	12	19	28	30	39	67	80	43	27	15	10	2	1	4	429

Correlation Table of Length and Width of Leaf in *O. Lamarckiana*. $p = 0.7916 \pm 0.0090$.

that all of the mutants are being given off by the whole species then these must be thrown into the struggle for existence under conditions widely different. In some cases one mutant finds itself equipped to survive in the given

environment, and it does so in competition with the native flora, including the parental form. In a different part of the natural range of the parental form, a second mutant might have the advantage, and it alone of the entire brood would survive, while a third would be the best form for still another set of conditions. So well in accord with the facts do we find this assertion, that it is not hazardous to predict that when a final survey of the distribution of *Oenothera grandiflora* and its mutants is made, some such arrangement will be found. With this idea we must also concede that many of the mutants, so far as our experience goes, do not meet at all the conditions suitable for their existence, and these perish. In brief we have natural selection, not a selection *within* species, but a selection *among* species, by which certain ones are elected for survival and others doomed to destruction no matter how numerous, or how long they may be thrown off by the parental type.

As to the periodicity of mutations our information is not very extensive. Does a species, as it produces generation after generation in the course of centuries, arrive at a point where it begins to give off atypic individuals, and is this process continued for a time and then discontinued? We can only say that we find some species mutating and others not, we have not seen either the opening or closing of the mutative period in any species. This consideration is complicated however with that of the frequency of the mutants. Thus in Lamarck's evening-primrose five in every hundred plants are mutants, one in every two hundred of *biennis*, and it is conceivable that the atypic form might not occur more than once in a thousand, or once in ten thousand, or once in a million. These large numbers of plants of any species are not all in existence at any one time, and it might take years, or even decades to bring one mutant within the range of the possible number, in which case a false conception of the mutative period might be

gained. It is suggested therefore that the conception of *frequency of mutation* is the primary idea, although the action might become intensified in certain periods, of more or less definite limits.

Finally we may consider the causes inducing or affecting mutations. Mutants are found to be the most numerous under conditions most favorable to the growth and reproduction of the parental type, and this is also true of all anomalous structures. It is thus to be seen that mutations probably do not give rise to species most readily under the stress of unfavorable environment, or under any conditions which weaken the parental form, but when it is at a maximum of activity.

In the attempts to localize the changes in the cells, or in the chromosomes, which result in the formation of atypic individuals from seeds we are confident for theoretical reasons that these ensue previous to the reducing or qualitative divisions in the formation of the egg, or in the pollen mother-cells. Just what this change may be, we are unable to say, and shall probably know no more about it until the cytologist shall have given us some clue to the manner in which the separate qualities are represented in the chromosomes, in which the mutative changes must ensue. It is self-evident that in a mutation, some characters or qualities being borne along steadily from cell to cell in the divisions must be thrown into a latent condition, or perhaps totally lost, while simultaneously or separately, other qualities may be acquired by what actual operation we do not know. It seems fairly obvious, however, that these saltations arising from the non-uniform action of the chromosomes, must take place in response to some stimulus outside of the protoplast in which it actually occurs. This by no means supposes that the stimulation comes from climatic, or other environmental factors, but in all probability results from enzymatic or other action from neighboring

masses of cells. If this is so then we may hope to be able to duplicate the process in our cultures and call out a proportion of mutants at our will. The results of experiments now in progress seem to lend great favor to this assumption.

This view of the case is also favored by the facts offered by bud-sports, which have been designated as "vegetative mutants, although as shown above, all mutations are essentially of a vegetative character. In the simplest forms of these sports, lateral buds arising generally near the base of a shoot develop branches which diverge definitely from the characters of the main shoot, and which usually coincide with some known form, although this is not always the case. Sometimes entirely new forms arise in this manner as in the case of seed-mutants. During the present season I have been so fortunate as to have three notable examples of bud-sports in the experimental cultures. One of these was a basal branch of *Oenothera ammophila* which sported into the characters of *O. biennis*, and suggesting a possible hybrid ancestry with the latter species as one of the parents. A second case was one in which a seed-mutant of *O. biennis* gave a bud-sport which bore the characters of the ancestral type or the true *O. biennis*. A third case was one in which a plant of one of the numerous types embraced in a complex hybrid progeny bore a branch which sported in a branch which resembled a sister type. Other anatomical relations are found. Thus a bud-sport may embrace not only a branch, but a portion of the main stem, from which it arises, or in other cases it may include a section or longitudinal strip along one side of a branch even dividing a flower or fruit, while in other cases it may be represented by single flowers or fruits scattered indiscriminately through an inflorescence.

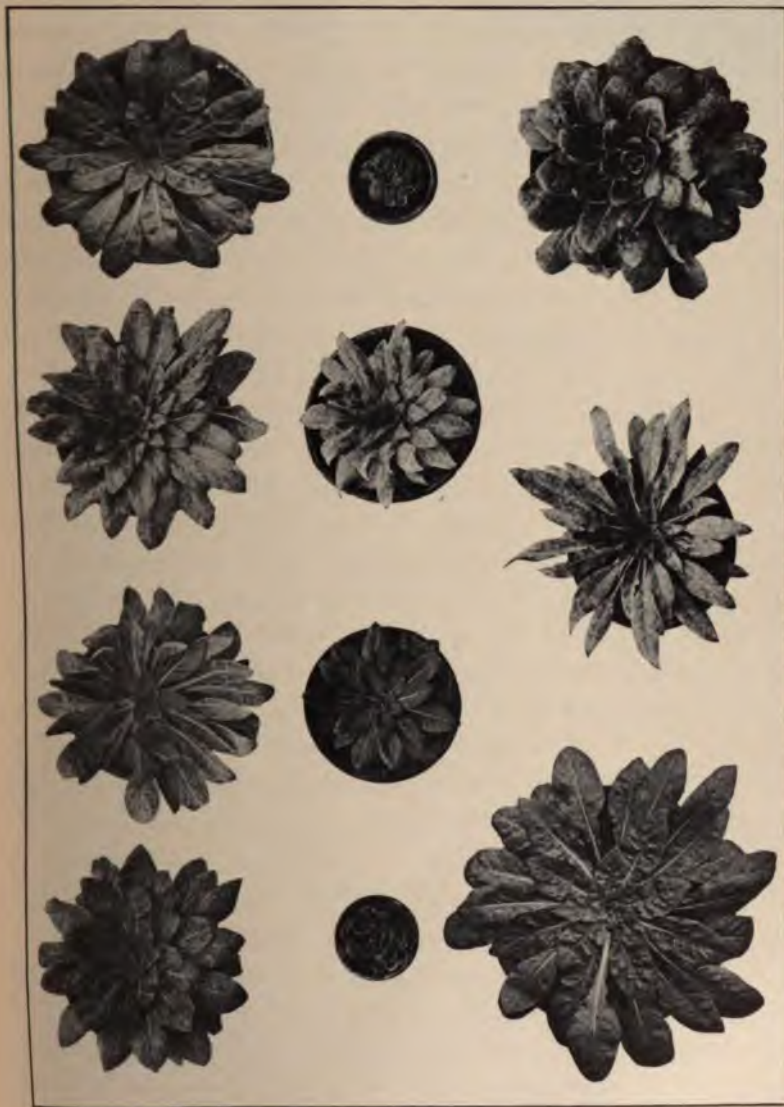
It is to be noted that in most if not all of the sectorial variations by which a part of a bud bears the divergent

characters, the change is a reversionary one, and the qualities that appear are really latent in the entire plant, and only need some stimulus to awaken them, or some agency to weaken the dominancy of the prevalent characters.

In the case of the appearance of characters not hitherto borne by the main stock, the case is not so clear, especially as we feel fairly certain that the saltations do ensue, in seed-mutants at least, in single cells. Here the theoretical side of the case seemed least supported by facts and I set about supplying the deficiency with what success you may presently judge.

Bud-sports are usually found on the basal portions of main stems of shoots, or in that part of the main axis, which often shows juvenile structures, so that we may say that these breaks in heredity are very frequent in the closing part of the embryonic period, although sometimes occurring much later. On the other hand, the changes which result in the formation of seed-mutants must ensue in the very closing stages of the sporophyte, and here is encountered a feature not recognized in bud-mutations, that of a fairly constant frequency, which in itself would suggest internal causes. It was determined however to attempt to induce or influence mutation in one of these periods. It was deemed impracticable to attempt this in the early life of the sporophyte and attention was given entirely to the stage immediately preceding the reducing divisions.

Omitting the detail of technique I may say that strong osmotic reagents, and weak solutions of stimulating mineral salts were injected into ovaries in such manner that unfertilized ovules were subjected to the action of the fluids, which killed many of them, but which gave the much desired results in a few. In *Lamarckiana* and *bien-nis* the frequency and character of the known mutants was unaffected, but in the progeny of the latter species was found a single individual constituting a type hitherto un-



Lamarck's Evening-primrose and Ten of Its Mutants. The dense rosette in the lower left-hand corner is *O. Lamarckiana*, the parental form. *O. gigas* is in the upper right-hand corner, and under it is *O. scintillans*. The irregular rosette above *O. Lamarckiana* is *O. albida*, and to the right of *albida* is *lata*. *O. oblonga* is in the upper left-hand corner.

known. This single aberrant individual might have been a mutant of low frequency, comparable to *gigas* derived from *Lamarckiana*, and its recurrence here might have been merely a matter of chance. However, in another species of evening - primrose, *Raimannia odorata*, a flower which belongs to a separate genus of the family, and is not known to be mutating, the treatment described resulted in a large number of aberrant individuals of a hitherto unknown type. Some of these, which show a shorter life-cycle than the parental form, and many anatomical divergencies, have been brought to bloom and to maturity, and the new form is obviously a potential species. In this experience, exemplified by specimens of the normal, parental forms, and aberrant mutants, I am able to offer you conclusive proof that agencies external to the cell may induce mutations, and consequently exert a profound influence on heredity. It would not be well to exaggerate the importance of this result, yet it is evident that the establishment of this fact marks a long step forward in the experimental study of inheritance and the origin of species.

A brief summary of the foregoing discussion may be made in the following generalizations:

1. Species may arise by hybridizations which result in fixed forms. A large number of forms known as species and recognized to be of such origin are known and a number of them have been duplicated in experimental cultures, some of which were made over a half century ago.
2. The mutation theory groups an enormous number of hitherto unexplainable facts, to which we are constantly adding in great volume, into a connected and meaningful whole, and best of all it brings the subject anew into a condition where it is amenable to experimental methods, in the laboratory, and experimental garden.
3. As a result of the theoretical conceptions offered us,

we have been able to make repeated observations of the general principles which govern breaks, or saltations in heredity, and to observe in what manner such mutations are connected with the origin of species.

4. Having ascertained at what time in the life-period of the individual mutations occur, I have been so fortunate as to secure results, demonstrating that mutations may be induced in a species not hitherto active in this respect, and that it is possible to call out new species by the intervention of external agents during the critical period.

5. Not less important than the foregoing is the unavoidable implication that breaks, saltations, or discontinuous action may be caused in inheritance by forces external to the protoplasts, and cells which are the true bearers of the hereditary characters.

Lastly it is of the greatest interest to note that in the effort to correlate the larger generalizations in the various departments of science in the concept of mutation we have hit upon a principle strongly favored by a modern system of mathematics, well exemplified by the spontaneous breaking-up and rearrangement of the complex atoms in radium, uranium and allied metals, and which has been recognized by Prof. George Darwin, the physicist, in the following words: "These considerations lead me to express a doubt whether biologists have been correct in looking for continuous transformation of species. Judging by analogy we should rather expect to find slight continuous changes occurring during a long period of time, followed by a somewhat sudden transformation into a new species, or by rapid extinction."

In the long-continued narrowing of the range of fluctuation in the various organs, coming to saltations, or direct origination of new forms, as the plant passes from generation to generation, we have as perfect a fulfilment of this motion as might be expected when an attempt is

made to interpret the action of the living by the properties of the non-living.

DANIEL TREMBLY MACDOUGAL.

NEW YORK BOTANICAL GARDEN.

MATHEMATICAL EMANCIPATIONS.

THE PASSING OF THE POINT AND THE NUMBER THREE: DIMENSIONALITY AND HYPERSPACE.

AMONG the splendid generalizations effected by modern mathematics, there is none more brilliant or more inspiring or more fruitful, and none more nearly commensurate with the limitless immensity of being itself, than that which produced the great concept variously designated by such equivalent terms as hyperspace, multidimensional space, n -space, n -fold or n -dimensional space, and space of n dimensions.

In science as in life the greatest truths are the simplest. Intelligibility is alike the first and the last demand of the understanding. Naturally, therefore, those scientific generalizations that have been accounted really great, such as the Newtonian law of gravitation, or the principle of the conservation of energy, or the all-conquering concept of cosmic evolution, are, all of them, distinguished by their simplicity and apprehensibility. To that rule the notion of hyperspace presents no exception. For its fair understanding, for a live sensibility to its manifold significance and quickening power, a long and severe mathematical apprenticeship, however helpful it would be, is not demanded in preparation, but only the serious attention of a mature intelligence reasonably inured by discipline to the exactions of abstract thought and the austerities of

the higher imagination. And it is to the reader having this general equipment, rather than to the professional mathematician as such, that the present communication is addressed.

To a clear understanding of what the mathematician means by hyperspace, it is in the first place necessary to conceive in its full generality the closely related notion of dimensionality and to be able to state precisely what is meant by saying that a given manifold has such and such a dimensionality, or such and such a number of dimensions, in a specified entity or element.

Discrimination, as the proverb rightly teaches, is the beginning of mind. The first psychic product of that initial psychic act is *numerical*: to discriminate is to produce *two*, the simplest possible example of multiplicity. The discovery, or better the invention, better still the production, best of all the creation, of multiplicity with its correlate of number, is, therefore, the most primitive achievement or manifestation of mind. Such creation is the immediate issue of intellection, nay, it is intellection, identical with its deed, and, without the possibility of the latter, the former itself were quite impossible. Accordingly it is not matter for surprise but is on the contrary a perfectly natural or even inevitable phenomenon that explanations of ultimate ideas and ultimate explanations in general should more and more avail themselves of analytic as distinguished from intuitionist means and should tend more and more to assume arithmetic form. Depend upon it, the universe will never be really understood unless it may be sometime resolved into an ordered multiplicity and made to own itself an everlasting drama of the calculus.*

Let us, then, trust the arithmetic instinct as funda-

* In this connection I take pleasure in referring the reader to the somewhat naïve indeed but none the less very suggestive and stimulating article "The Warp of the World" by Mr. Newman Howard, *Hibbert Journal*, January, 1905.

mental and, for instruments of thought that shall not fail, repair at once to the domain of number. Every one who may reasonably aspire to a competent knowledge of the subject in hand is more or less familiar with the system of real numbers, composed of the positive and negative integers and fractions, such irrational numbers as $\sqrt{2}$ and π and countless hosts of similar numbers similarly definable. He may know that, for reasons which need not be given here, the system of real numbers is commonly described as the analytical continuum of first order. He knows, too, at any rate it is a fact which he will assume and readily appreciate, that the distance between any two points of a right line is exactly expressible by a number of the continuum; that, conversely, given any number, two points may be found whose distance apart is expressed by the numerical value of that number; that, therefore, it is possible to establish a unique and reciprocal, or one-to-one, correspondence between the real numbers and the points of a straight line, namely, by assuming some point of the line as a fixed point of reference or origin of distances, by agreeing that a distance shall be positive or negative according as it proceeds from the origin in this sense or in the other and by agreeing that a *point* and the *number* which by its magnitude reckoned in terms of a chosen finite unit however great or small serves to express the distance of the point from the origin and by its sign indicates on which side of the origin the point is situated, shall be a pair of *correspondents*. Accordingly, if the point P glides along the line, the corresponding number v will vary in such a way that to each position of the geometric there corresponds one value of the arithmetic element, and conversely. P represents v ; and v , P . No two P 's represent a same v ; and no two v 's, a same P . By virtue of the correlation thus established with the *analytical* continuum, we may describe the line as a simple

or one-fold *geometric* continuum, namely, of points. The like may in general be said, and for the same reason, of any curve whatever, but we select the straight line as being the simplest, for in matters fundamental we should prefer clearness to riches of illustration, in the faith that, if first we seek the former, the latter shall in due course be added unto it. The straight line, when it is regarded as the domain of geometric operation, as the region or room containing the configurations or sets of elements with which we deal, is and is called a *space*; and this space, viewed as the manifold or assemblage of its points, is said to be *one-dimensional* for the reason that, as we have seen, in order to determine the position of a point in it, in order, i. e., to pick out or distinguish a point from all the other points of the manifold, it is necessary and sufficient to know one fact about the point, as, e. g., its distance from an assumed point of reference. In other words, the line is called a one-dimensional space of points because in that space the point has one and but one degree of freedom or, what is tantamount, because the position of the point depends upon the value of a single v , known as its coordinate.

Herewith is immediately suggested the generic concept of dimensionality: *if an assemblage of elements of any given kind whatsoever, geometric or analytic or neither, as points, lines, circles, triangles, numbers, notions, sentiments, hues, tones, be such that, in order to distinguish every element of the assemblage from all the others, it is necessary and sufficient to know exactly n independent facts about the element, then the assemblage is said to be n -dimensional in the elements of the given kind.* It appears, therefore, that the notion of dimensionality is by no means exclusively associated with that of space but on the contrary may often be attached to the far more generic concept of assemblage, aggregate or manifold. For ex-

ample, duration, the total aggregate of time-points, or instants, is a simple or one-fold assemblage. On the other hand, the assemblage of colors is three-dimensional as is also that of musical notes, for in the former case, as shown by Clerk Maxwell, Thomas Young and others, every color is composable as a definite mixture of three primary ones and so depends upon three independent variables or coordinates expressing the amounts of the fundamental components. And in the latter case a similar scheme obtains, one note being distinguishable from all others when and only when the three general marks, pitch, length, and loudness, are each of them specified. In passing it seems worth while to point out the possibility of appropriating the name *soul* to signify the *manifold* of all *possible* psychic *experiences*, in which event the term would signify an assemblage of probably *infinite* dimensionality, and the assemblage would be continuous, too, if Oswald* be right in his contention that every manifold of experience possesses the character of continuity. That contention, however, if the much abused term continuity be allowed to have its single precise definitely seizable scientific meaning, is far less easy to make good than that eminent chemist and courageous philosopher seems to think.

Returning to the concept of space, an *n*-fold *assemblage* will be an *n*-dimensional *space* if the elements of the assemblage are geometric entities of any given kind. We have seen that the straight line is a *one*-dimensional space of *points*. But in studying the right line conceived as a space, we are not compelled to employ the point as element. Instead we may choose to assume as element the point *pair* or *triplet* or *quatrain*, and so on. The line would then be for our thought primarily a space, not of points, but of point pairs or triplets and so on, and it would accordingly be strictly a space of *two dimensions* or of *three*,

* Cf. his *Natur-Philosophie*.

and so on; for, obviously, to distinguish say a point pair from all other such pairs we should have to know *two* independent facts about the pair, one of which would determine one of the points, and the other, the other. The pair would have two degrees of freedom in the line, its determination would depend upon two independent variables as v_1 and v_2 referred to two (in general different) points of reference. It should be signalized that a pair of points is not merely two points, nor a triplet merely three. *Order* is essential, and two points will furnish two distinct pairs, and three points will furnish six pairs or six triplets; on the other hand, three pairs or three triplets may contain but three points. On its arithmetic side the shield presents a precisely parallel doctrine. The simple analytical continuum composed of the real numbers immediately loses its simplicity and assumes the character of a 2- or 3-... or n -fold analytical continuum if, instead of thinking of its individual numbers, we view it as an aggregate of number pairs or triplets or, in general, as the totality of ordered systems of n numbers each.

In the light of the preceding paragraph it is seen that the dimensionality of a given space is not unique but depends upon the choice of geometric entity for primary or generating element. A space being given, its dimensionality is not therewith determined but depends upon the will of the investigator, who by a proper choice of generating element may endow the space with any dimensionality he pleases. That fact is of cardinal significance alike for science and for philosophy. I reserve for a little while its further consideration in order to present at once a kind of complementary fact of equal interest and of scarcely less importance. It is that two spaces which in every other respect are essentially unlike, thoroughly disparate, may, by suitable choice of generating elements, be made to assume equal dimensionalities. Consider, for example.

the totality of lines contained in a same plane and containing a point in common. Such a totality, called a *pencil*, of lines is a simple geometric continuum, namely, of lines. It is, then, and may be called, a *one-dimensional* space of *lines* just as the line or *range* of points is a one-dimensional space of points. The two spaces are equally rich in their respective elements. And if, following Desargues and his successors, we adjoin to the points of the range a so-called "ideal" point or point at infinity, thus rendering the range like the pencil, *closed*, it becomes obvious that two intelligences, adapted and confined respectively to the two simple spaces in question, would enjoy equal freedom; their analytical experiences would be identical, and their geometries, though absolutely disparate in kind, would be equally rich in content. Just as the range-dweller would discover that the dimensionality of his space is *two* in *point pairs*, *three* in *triplets*, and so on, so the pencil-inhabitant would find his space to be of dimensionality *two* in *line pairs*, *three* in *triplets*, and so on without end. It was indicated above that *any* line, straight or *curved*, is a *one-dimensional* space of *points*. In that connection it remains to say that, speaking generally, *any curve*, literally and strictly conceived as the assemblage of its (tangent) lines and so including the point or pencil as a special case, is also a *one-dimensional* space of *lines*. It is, moreover, obvious that the foregoing considerations respecting the range of points and the pencil of lines are, *mutatis mutandis*, equally valid for any one of an infinite variety of other analogous spaces, as, e. g., the *axal pencil*, a one-fold space of planes, consisting of the totality of planes having a line in common.

If perchance some reader should feel an ungrateful sense of impropriety in our use of the term *space* to signify such common geometric aggregates as we have been considering, I gladly own that his state of mind is a per-

fectly natural one. But it is, besides and on that account, a source of real encouragement. Dictional sensibility is a hopeful sign, being conclusive evidence of life, and, while there is life, there remains the possibility and therewith the hope of readjustment. In the present case, I venture to assure the reader, on grounds both of personal experience and of the experience of others, that whatever sense he may have of injury received will speedily disappear in the further course of his meditations. Only, let him not be impatient. Larger meanings must have time to grow; the smaller ones, those that are most natural and most provincial, being also the most persistent. In the process of clarification, expansion and readjustment, his fine old word, space, early come into his life and gradually stained through and through with the refracted partial lights and multi-colored prejudices of his youth, is not to be robbed of its proper charms nor to be shorn of its proper significance. More than it will lose of mystery, it shall gain of meaning. Of this last it has hitherto had for him but little that was of scientific value, but little that was not vague and elusive and ultimately unseizable. That was because the word stood for something absolutely *sui generis*, i. e., *for a genus neither including species nor being itself included in a class*. But now, on the other hand, both of these negatives are henceforth to be denied, and the hitherto baffling term, perfect symbol of the unthinkable, always promising and never presenting definable content, immediately assumes the characteristic twofold aspect of a genuine concept, being at once included as member of a higher class, the more generic class of manifolds, and including within itself an endless variety of individuals, an infinitude of species of space.

Of these species, the next, in order of simplicity, to those above considered, is the plane. To distinguish a point of a plane from all its other points, it is necessary

and sufficient to know *two* independent facts about its position, as, e. g., its distances from two assumed lines of reference, most conveniently taken at right angles. Viewed as the *ensemble* of its points, the plane is, therefore, a space of *two* dimensions. In that space, the point enjoys a freedom exactly twice that of a point in a range or of a line in a pencil, and exactly equal to that of a *pair* of points or of lines in the last-mentioned spaces. On the other hand, if the point *pair* be taken as element of the plane, the latter becomes a space of *four* dimensions.

What if the *line* be taken as generating element? It is obvious that the plane is equally rich in pencils and in ranges. It contains as many lines as points, neither more nor less. Two points determine a line; two lines, a point; if the lines be parallel, their common point is a Desarguesian, a point at infinity. We should therefore expect to find that in a plane the position of a line depends upon two and but two independent variables. And the expectation is realized, as it is easy to see. For if the variables be taken to represent (say) distances measured from chosen points along two lines of reference, it is immediately evident that a given pair of values of the variables determines a line uniquely and that, conversely, a given line uniquely determines such a pair. The plane is, therefore, a *two*-dimensional space of *lines* as well as of points. In line *pairs*, as in point pairs, its dimensionality is *four*. We may suppose the space in question to be inhabited by two sorts of individuals, one of them capable of thinking in terms of points but not of lines, the other in terms of lines but not of points. Each would find his space bi-dimensional. They would enjoy precisely the same analytical experience. Between their geometries there would subsist a fact-to-fact *correspondence* but not the slightest *resemblance*. For example, the circle would be for the former individual a certain assemblage of points but devoid of

tangent lines, and, for the latter, a corresponding assemblage of (tangent) lines but devoid of contact points.

Passing from the plane to a curved surface, to a sphere, for example, a little reflection suffices to show that the latter may be conceived in a thousand and one ways, most simply as the ensemble of its points *or* of its (tangent) planes *or* of its (tangent) lines. These various concepts are logically equivalent and in themselves are equally intelligible. And if to us they do not seem to be also equally *good*, that is doubtless because we are but little traveled in the great domain of Reason and therefore naturally prefer our familiar customs and provincial points of view to others that are strange. At all events, it is certain that on purely *rational* grounds, none of the concepts in question is to be preferred, while, from preference based on *other* grounds, it is the office alike of science and of philosophy to provide the means of emancipation. Let us, then, detach ourselves from the vulgar point of view and for a moment contemplate the three concepts as coordinate indeed but independent concepts of surface. And for the sake of simplicity, we may think of a sphere.* Suppose it placed upon a plane and imagine its highest point, which we may call the pole, joined by straight lines to all the points of the plane. Each line pierces the sphere in a second point. It is plain that thus a one-to-one correspondence is set up between the points of the sphere and those of the plane, except that the pole corresponds at once to all the Desarguesian points of the plane—an exception, however, which is here of no importance. The plane and the sphere are, then, equally rich in points. Accordingly, the sphere conceived as a plenum or locus of *points* is a space of *two* dimensions. In that space the point has two degrees of freedom. Its position depends upon two independent vari-

* The term is here employed as in the higher geometry to denote, not a solid, but a surface.

ables, as latitude and longitude. But we may conceive the surface quite otherwise: at each of its points there is a (tangent) plane, and now, *disregarding points*, we may think only of the assemblage of those planes. These together constitute a sphere, not, however, as a locus of points, but as an envelope (as it is called) of planes. And what shall we say of the surface as thus conceived? The answer obviously is that it is a *two-dimensional* space of *planes*, admitting of a geometry quite as rich and as definite as is the theory of any other space of equal dimensionality. In each of the planes there is a pencil of lines of which each is tangent to the sphere. Thus we are led to a third conception of our surface. We have merely to disregard both points and planes and confine our attention to the assemblage of lines. The vision which thus arises is that of a *three-dimensional* space of *lines*. In pencils, its dimensionality is two. In this space the pencil has two and the line three degrees of freedom.

But let us return to the plane. We have seen that at the geometrician's bidding it plays the rôle of a twofold space either in points or in lines. It is natural to ask whether it may be conceived as a space of *three* dimensions, like the sphere in its third conception. The answer is affirmative: it may be so conceived, and that in an infinity of ways. Of these the simplest is to assume the *circle* as primary or generating element. Of circles the plane contains a threefold infinity, an infinity of infinities of infinity. It is a circle continuum of third order. To distinguish any one of its circles from all the rest, three independent data, two for position and one for size, are necessary and sufficient. In the plane the circle has three degrees of freedom, its determination depends upon three independent variables. The plane is, accordingly, a *three-dimensional* space of *circles*. In *parabolas* its dimensionality is *four*; in *conics*, *five*; and so on *without limit*.

Before turning to space, ordinarily so-called, it seems worth while to indicate another geometric continuum which, although it presents no *likeness* whatever to the plane, nevertheless *matches* it perfectly in every conceptual aspect. The reference is to the *sheaf*, or *bundle*, of *lines*, i. e., the totality of lines having a point in common. The point is to be disregarded and the lines viewed as non-decomposable entities, like points in a line or a plane regarded as an assemblage of points. Thus conceived, the *sheaf* is literally a *space*, namely, of *lines*. It is, in the vulgar sense of the term, just as *big*, occupies precisely as much room, nay indeed the same room, as the space in which we live. The sheaf as a space is *two-dimensional* in *lines*, like the *plane* in *points*; *two-dimensional* in *pencils*, like the *plane* in *lines*; *four-dimensional* in *line* or *pencil pairs*, like the *plane* in *point* or *line pairs*; *three-dimensional* in ordinary *cones*, like the *plane* in *circles*; and so on and on.

In the light of the foregoing considerations, any hitherto uninitiated reader will probably suspect that ordinary space is *not*, as it is commonly supposed and said to be, an *inherently* and *uniquely three-dimensional* affair. His suspicion is completely justified by fact. The simple traditional affirmation of tri-dimensionality is devoid of definite meaning. It is unconsciously elliptic, requiring for its completion and precision the specification of an appropriate geometric entity for generating element. Merely to say that space is tri-dimensional because a solid, e. g., a plank, has length, breadth and thickness, is too crude for scientific purposes. Moreover, it betrays, quite unwittingly indeed as we shall see, an exceedingly meager point of view. Not only does it assume the *point* as element but it does so tacitly because unconsciously, as if the point were not merely *an* but *the* element of ordinary space. *An* element the point may obviously be taken to be, and in

that element ordinary space is indeed tri-dimensional, for the position of a point at once determines and is determined by three independent data, as its distances from three assumed mutually perpendicular planes of reference. It must be admitted, too, that the point does, in a sense, recommend itself as the element *par excellence*, at least for practical purposes. For example, we prefer to do our drawing with the point of a pencil to doing it with a straight edge. But that is a matter of physical as distinguished from rational convenience. Preference for the point has, then, a cause: in the order of evolution, practical man precedes man rational and determines for the latter his initial choices. Causes, however, are extra-logical things, and the preference in question, though it has indeed a cause, has no reason. Accordingly, when in these modern times, the geometrician became clearly conscious that he was in fact and had been from time immemorial employing the point as element and that it was this use that lent to space its traditional triplicity of dimensions, he did not fail to perceive almost immediately the logically equal possibility of adopting at will for primary element any one of an infinite variety of other geometric entities and so the possibility of rationally endowing ordinary space with any prescribed dimensionality whatever.

Thus, for example, the plane is no less available for generating element than is the point. The plane is logically and intuitionally just as simple, for, if from force of habit, we are tempted to analyze the plane into an assemblage of points, the point is in its turn equally conceivable as or analyzable into an assemblage of planes, the sheaf of planes containing the point. We may, then, regard our space as primarily a plenum of planes. To determine a plane requires three and but three independent data, as, say, the distances to it measured along three chosen lines from chosen points upon them. It follows that ordinary

space is *three-dimensional* in *planes* as well as in points. But now if (with Plücker) we think of the *line* as element, we shall find that our space has *four* dimensions. That fact may be seen in various ways, most easily perhaps as follows. A line is determined by any two of its points. Every line pierces every plane. By joining the points of one plane to all the points of another, all the lines of space are obtained. To determine a line it is, then, enough to determine two of its points, one in the one plane and one in the other. For each of these determinations, two data, as before explained, are necessary and sufficient. The position of the line is thus seen to depend upon four independent variables, and the four-dimensionality of our space in lines is obvious. Again, we may (with Lie) view our space as an assemblage of its *spheres*. To distinguish a sphere from all other spheres, we need to know four and but four independent facts about it, as, say, three that shall determine its center and one its size. Hence our space is *four-dimensional* also in *spheres*. In *circles* its dimensionality is *six*; in *surfaces* of *second order* (those that are pierced by a straight line in two points), *nine*; and so on *ad infinitum*.

Doubtless the reader is prepared to say that, if the foregoing account of hyperspace be correct, the notion is after all a very simple one. Let him be assured, the account is correct and his judgment is just: the notion is simple. That property, as said in the beginning, is indeed one of its merits. As presented the concept is entirely free from mystery. To seize upon it, it is unnecessary to pass the bounds of the visible universe or to transcend the limits of intuition. Its realization is found even in the line, in the pencil, in the plane, in the sheaf, here, there and yonder, everywhere, in fact. The account, however, though quite correct, is not yet complete. The term hyperspace has yet another meaning and yet in strictness not

another, as we shall see. It will be noticed that among the foregoing examples of hyperspace, none is presented of dimensionality *exceeding three* in *points*. It is precisely this variety of hyperspace that the term is commonly employed to signify, particularly in popular enquiry and philosophical speculation. And it is this variety, too, that just because it baffles the ordinary visual imagination, proves to be, for the non-mathematician at any rate, at once so tantalizing, so mysterious and so fascinating.

It remains, then, to ask, what is meant by a hyperspace of *points*? How is the notion formed and what is its motivity and use? The path of enquiry is a familiar one and is free from logical difficulty. Granted that a one-to-one correspondence can be established between the real numbers and the points of a right line, so that the geometric serve to represent the arithmetic elements; granted that all (ordered) pairs of numbers are similarly representable by the points of a plane, and all (ordered) triplets by the points of ordinary space; the suggestion then naturally presents itself that, whether there really is or not, there *ought* to be a *space* whose *points* would serve to *represent*, as in the preceding cases, *all ordered systems* of *values* of *n independent variables*; and especially to an analyst with a strong geometric predilection, to one who is a born *Vorstellender*, for whom analytic abstractions naturally tend to take on figure and assume the exterior forms of sense, that suggestion comes with a force which he alone perhaps can fully appreciate. And what does he do? Not finding the desiderated hyperspace present to his *vision* or *intuition* or *visual imagination*, he *posits* it, or if you prefer, he *creates it, in thought*. The concept of hyperspace of points is thus seen to be off-spring of Arithmetic and Geometry. It is legitimate fruit of the indissoluble union of the fundamental sciences.

Does such hyperspace exist? It does exist genuinely.

If not for intuition, it exists for conception; if not for imagination, it exists for thought; if not for sense, it exists for reason; if not for matter, it exists for mind. These if's are *if's* in fact. The question of imaginability is really a question. We shall return to it presently.

The concept of hyperspace of points is generable in various other ways. Of all ways the following is perhaps the best because of its appeal at every stage to intuition. Let there be two points and grant that these determine a *line*, point-space of *one* dimension. Next posit a point *outside* of this line and suppose it joined by lines to all the points of the given line. The points of the joining lines together constitute a *plane*, point-space of *two* dimensions. Next posit a point outside of this plane and suppose it joined by lines to all the points of the plane. The points of all the joining lines together constitute an ordinary *space*, point-space of *three* dimensions. The clue being now familiar to our hand, let us boldly pursue the opened course. Let us overleap the limits of common imagination, transcend ordinary intuition as being at best but a non-essential auxiliary, and in *thought* posit an extra point that, *for thought* at all events, shall be *outside* the space last generated. Suppose that point joined by lines to all the points of the given space. The points of the joining lines together constitute a point-space of *four* dimensions. The process here applied is perfectly clear and obviously admits of endless repetition.

Moreover, the process is equally available for generating hyperspaces of other elements than points. For example, let there be two intersecting lines and grant that these determine a *pencil*, line-space of *one* dimension. Next posit a line (through the vertex) *outside* of the given pencil and suppose it joined by pencils to all the lines of the given pencil. The lines of the joining pencils together constitute a *sheaf*, line-space of *two* dimensions. Next

posit a line (through the vertex) *outside* of the sheaf and suppose it joined by pencils to all the lines of the sheaf. The lines of the joining pencils constitute a *hypersheaf*, line-space of *three* dimensions. The next step plainly leads to a line-space of *four* dimensions; and so on *ad infinitum*.

And now as to the question of imaginability. Is it possible to intuit configurations in a hyperspace of points? Let it be understood at the outset that that is not in any sense a mathematical question, and mathematics as such is quite indifferent to whatever answer it may finally receive. Neither is the question primarily a question of philosophy. It is first of all a psychological question. Mathematicians, however, and philosophers are also men and they may claim an equal interest perhaps with others in the profounder questions concerning the potentialities of our common humanity. The question, as stated, undoubtedly admits of affirmative answer. For the lower spaces, with which the imagination is familiar, exist *in* the higher, as the line in the plane, and the plane in ordinary space. But that is not what the question means. It means to ask whether it is possible to imagine hyper-configurations of points, i. e., point-configurations that are not wholly contained in a point-space (like our own) of three dimensions. It is impossible to answer with absolute confidence. One reason is that the term imagination still awaits precision of definition. Undoubtedly just as three-dimensional figures may be represented in a plane, so four-dimensional figures may be represented in space. That, however, is hardly what is meant by imagining them. On the other hand, a four-dimensional figure may be rotated and translated in such a way that all of its parts come one after another into the threefold domain of the ordinary intuition. Again, *the structure of a fourfold figure, every minutest detail of its anatomy, can be traced out by analogy with its three-dimensional analogue.* Now in such

processes, repetition yields skill, and so they come ultimately to require only amounts of *energy* and of *time* that are quite *inappreciable*. Such skill once attained, the *parts* of a familiar *fourfold configuration* may be made to pass before the eye of intuition in such *swift* and *effortless* succession that the configuration *seems present as a whole in a single instant*. If the *process* and *result* are not, properly speaking, *fourfold imagination* and *fourfold image*, it remains for the psychologist to indicate what is lacking.

Certainly there is naught of absurdity in supposing that under suitable stimulation the human mind may in course of time even speedily develop a spatial intuition of four or more dimensions. At present, as the psychologists inform us and as every teacher of geometry discovers independently, the spacial imagination, in case of very many persons, comes distinctly short of being strictly even tri-dimensional. On the contrary, it is flat. It is not every one, even among scholars, that with eyes closed can readily form a visual image of the *whole* of a simple *solid* like a sphere, enveloping it completely with bent beholding rays of psychic light. In such defect of imagination, however, there is nothing to astonish. In the first place, man as a race is only a child. He has been on the globe but a little while, long indeed compared with the fleeting evanescents that constitute the most of common life, but very short, the merest fraction of a second, in the infinite stretch of time. In the second place, circumstances have not, in general, favored the development of his higher potentialities. His chief occupation has been the destruction and evasion of his enemies, contention for mere existence against hostile environment. Painful necessity, then, has been the mother of his inventions. That, and not the vitalizing joy of self-realization, has for the most part determined the selection of the fashion of his faculties.

But it would be foolish to believe that these have assumed their final form or attained the limits of their potential development. The imperious rule of necessity will relax. It will never pass quite away but it will relax. It is relaxing. It has relaxed appreciably. The intellect of man will be correspondingly quickened. More and more will joy in its activity determine its modes and forms. The hyper-dimensional worlds that man's reason has already created, his imagination may yet be able to depict and illuminate.

It remains to ask, finally, what purpose the concept of hyperspace subserves. Reply, partly explicit but chiefly implicit, is not, I trust, entirely wanting in what has been already said. Motivity, at all events, and *raison d'être* are not far to seek. On the one hand, the great generalization has made it possible to enrich, quicken and beautify analysis with the terse, sensuous, artistic, stimulating language of geometry. On the other hand, the hyperspaces are in themselves immeasurably interesting and inexhaustibly rich fields of research. Not only does the geometrician find light in them for the illumination of many otherwise dark and undiscovered properties of the ordinary spaces of intuition, but he also discovers there wondrous structures quite unknown to ordinary space. These he examines. He handles them with the delicate instruments of his analysis. He beholds them with the eye of the understanding and delights in the presence of their super-sensuous beauty.

It is by creation of hyperspaces that the rational spirit secures release from limitation. In them it lives ever joyously, sustained by an unfailing sense of infinite freedom.

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immortality. Yet his views are peculiar and differ greatly from the current belief in that they are based upon certain scientific considerations. It seems worth while to study them, for they contain much that is good and true; and though one of his most essential arguments is wanting in logical conclusiveness, it is highly desirable that his conception be better known and more generally appreciated.

We propose here to sketch Fechner's view of the soul and point out where we part company with him.

Professor Fechner divides human life into first, the period before birth; then, life from birth to death; and thirdly, existence after death. He makes use of some ingenious analogies between the relation of man's prenatal condition in his mother's womb to his actual life, and of actual life to his fate after death. But in my opinion the division is not well chosen, and so the analogies fall to the ground. Man's life in this world does not begin with birth but with conception; and we ought to consider as his pre-existence, not his foetal life, but all the causes which in their co-operation lead to the rise of his personality as a concrete being endowed with reason and pursuing purposes according to his individual character. This individual existence is dissolved in death, and the great question with mankind has ever been, If a man die, shall he live again?*

It may be wise to insist first of all upon the reality of soul-life. Not only are our sentiments actual events (indeed they are the stuff that life is made of, and are the bottom facts of all experience) but they are even more real than material objects; for after all they are un-

*The problem of man's fate after death ought to be determined by an investigation of the conditions that caused his present life, and in this sense the author has tried to solve the problem in a pamphlet entitled *Whence and Whither?* (Chicago, The Open Court Publishing Company, 1900). As it is not necessary to repeat the arguments here, the reader is referred to it for questions of detail.

equivocal and primary, while the existence of matter is a mere inference, a deduction made from sensations, since matter itself is but a name that signifies certain constants in the complex causes of our sensations. Yet, since sensations are fleeting and depend upon very complex conditions, it is claimed that they are unsubstantial and transient phenomena. While this may be true, we must point out that they are none the less actual for they are efficient; they leave traces, and so each mental state continues to live in its effect. The continuity of a person depends upon the preservation of his sentiments, as they are registered in the nervous tissue, the psychological aspect of which is called memory.

Soul-life may be fleeting, but there is a stability in its phenomena that is simply an application of the general law of cause and effect which makes every fact that ever happened an indestructible factor in the constitution of the world. Whatever has been done leaves an indelible trace constituting the past in the development of the world; and in its entire makeup the act is irrevocable, and is at the same time the determinant of the present and through the present, of the future. Accordingly, it is obvious that man's soul being a part of the web and woof of the universe will stay forever, and if a man dies we can state at once that his life will have its influence upon the future—it will be incorporated in the constitution of the universe, at least as much as any other event.

But man's life is preserved in a higher degree in the lives of future generations. Every single individual is, physically considered, but the continued growth of his parents, and through example as well as education he imbibes the quintessence of all the spiritual wealth of former generations. Every soul is made a trysting place of former souls. The thoughts of others continue in us. Every mind is a great republic of ideas, of impulses, of sent

ments. It is a congregation of spirits who constitute a community in which they co-operate or antagonize each other; and in the measure that we live, and work, and are up and doing, we communicate our modes of thinking to others. With every sentence that we speak, or write, or have printed, and with every example which we set in our acts, we scatter spiritual seeds. Each soul migrates into others and takes root in a new soil, where it sprouts, continuing its own life under new circumstances, taking a new start, and yet remaining the selfsame tendency, the selfsame aspiration, the selfsame spirit.

It is apparent that the individual is not a true unit. We might with greater truth consider the ideas which take hold of the soul as units—as citizens which take up their abode in one mind and continue their existence in others. On the other hand we might also with greater truth consider the whole of mankind as a unit while man's individual existence is merely a middle link between the two, a device by which they are temporarily realized in flesh and blood in order to give them tangible existence.

Fechner's book is refreshing because his exposition of soul-life after death insists vigorously on the reality of this spiritual life which plays such an essential part in the constitution of our individual existence.

The memory of the dead is not a mere abstraction or sham, but constitutes the true presence of the souls of our beloved ones. They are here within us—nearer to us than our heart-beat; for their very souls, their thoughts, the examples which they set us, and their characters, constitute a portion of our own being. In the same way we, too, lead a spiritual life in the thoughts of others, our friends and also our foes, which will continue even when we are gone, and thus, though man must die, his soul will live.

Some details of Fechner's conception of life after death

are graphically described and unequivocally true. But he is misguided by his allegories when comparing man's life to his prenatal existence in his mother's womb, and thus the comparisons are frequently inappropriate. Our pre-existence is of a spiritual kind, and is not individual though it is definite and concrete. It is scattered over the whole realm of earthly conditions, and incorporates in an unbroken line our entire direct ancestry since the beginning of life on earth which is represented in innumerable simultaneous individuals. It is obvious that the constituents of one soul have been in many different individuals at once, and so also after death the soul of the departed will reappear not only once, but in many personalities whose destinies it will more or less determine.

But people clamor for a conscious immortality, saying that if they do not know that they are the same personalities they will not care for living after death. I would answer first of all that as much as in our present souls the the spirits of the past become conscious again, so our ideals and aspirations will be lighted up by the consciousness of future generations. If it be claimed that the consciousness of others is not our consciousness, I would answer that their very demand is based upon a gross materialistic conception of sameness; for even in our present existence every day's consciousness is in its way different from every other; and its successive phases can as little, and yet at the same time, as much, be regarded as the same, as the consciousness of successive generations. The whole problem is a matter of continuity, and the continuity of consciousness in one individual is as much broken up by sleep into successive days, as in the whole of mankind it is broken up into separate individuals. Every individual is as much a continuation of former individuals as one day in our life is the continuation of former days. In both cases continuity is complete, and the disruption

by sleep or by death touches merely the surface and does not disturb the integrity of the process of growth, evolution, historic development, or whatever we may call the cosmic background of our immortality.

The point where I would differ from Professor Fechner is when he attributes an objective existence to spirits as if they were concrete beings endowed with a consciousness of their own, and being able to act as if they were still individual beings like ourselves in what he describes as the second or earthly stage of being.

I do not deny that every soul remains a unit of its own. Great personalities, such as Christ, Shakespeare, Goethe, Washington, impress themselves on coming generations; and though they live in many, they retain their individuality and typical character. What is true of these great men is true in a minor degree of every one of us, but the unit of our individuality is not atomistic. It is not the unit of substance but the unification of a system. The main fault by which a spiritualistic soul-conception is vitiated consists in the materialization of the soul as if it were a thing or a bodily entity which at death takes wings and is subject to the law of matter that limits it to a definite existence in space. We have seen that spiritual life is not tied to space, and though it is definite and of a typical character it may be in several places at once.

Professor Fechner's idea of the soul suggests the assumption of spiritualistic conceptions, and he goes so far as to look upon abnormal soul-life as an indication of that higher form of existence which awaits us in the life to come. Here is the place where we cannot agree with his propositions although considering his inclinations we must confess that he has made a moderate use of this line of argument.

* * *

We may be permitted to recapitulate our view of the nature of the soul as being the significance of sentient

symbols. The soul originates from sentient substance. Sense impressions are being made, and in repetition the same sense impressions are felt to be the same. Hence a feeling of sameness is produced and this feeling comes to represent or symbolize the cause that produces the sense impression. Thus the soul grows naturally wherever sentience exists, and from the variety of feelings which have become representative of the various sense impressions of the surrounding world, becomes the soul of man by the formation of language. With the help of words things are classified. Abstraction and generalization become possible and reason throws a flood of light upon the laws of being. The essential feature of soul-life is not, however, its tendency to classify and comprehend things, but the practical application of reason, its ability to direct and predetermine the course of events and so to become master of the situation. In a word, purpose is the characteristic feature of soul-life.

In this interpretation of soul which brings forth the salient feature of its nature, we see at once that substance or material, though indispensable, is of slight importance, and our psychology need not enter into details of physiological processes. We see, too, that the efficiency of a soul consists in the transfer of symbols which are understood by other souls. Whether or not the essential part of cerebral activity be constituted by the interaction of nitrogen and oxygen, or whether the ether and electric processes play an important part, is quite immaterial and can throw no light on the nature of the soul. At the same time it disposes of the assumption that a soul may consist of some sublimated substance of imponderable matter, and that this substance remains preserved in afterlife as a kind of ethereal personality which according to ancient belief was ascribed to spiritual beings such as angels, ghosts, and gods.

But at this point I hear the anxious question: If the soul is not somehow substantial, if it is merely the purpose and character of the will and the ideas which we are thinking, is it not then a mere nonentity which leaves us nothing but a barren nihilism? My answer is: Not at all. It is the nature of the spiritual not to be material, and substance of any kind, be it conceived as ever so refined or sublimated, remains material; and any soul-conception which has not worked itself out into the clearness of conceiving the soul as pure form, falls short of the truth. But I grant that man is still so materialistic in his conceptions that he stands in constant need of materialistic allegories, and the soul has been represented in art since the days of Egyptian culture as a winged figure of luminous nature, visible only to the eye of the spiritually minded. All this is mere poetry which however develops naturally in man's imagination, and though the soul is not an astral body, not a luminous substance, not a sublimated entity of any kind, it is in itself real enough.

The essential feature of the soul is form, for form constitutes the type, and the form of the soul is character. Not that we feel is of importance but what we feel; not that we live, but how we live. But man wants life and soul and spirit to be substances as thick and clumsy as rocks, and as gross and coarse as our bodies; and there are many who imagine that if form is the essential feature of existence, our philosophy will end in nihilism.

Schiller castigates the sensualism which dominates the opinions of vast numbers of religious people, in a couplet called the "God-eaters," or *Theophagi*:

"How they seek pleasure in all! These gluttons are eating ideas.
Spoons they will carry, and forks, into the kingdom of God!"

Theological hedonism is the secret reason of all narrowness; it is sensual to the core and would not brook a

spiritual conception of the letter of religious dogmas. Thoughtless people cling to the allegory of the parable because it pleases the senses, and scorn its significance because the spirit escapes them. When sensualism no longer rules supreme, the time will come in which a philosophic conception of religion will be better appreciated.

Let us learn that form, though not a substance, is the reality of life, it is the superreal. The value of life lies not in its length, not in the number of years, not in the amount of happiness attained in it; but in the *direction* in which it tends and the *purpose* which it serves. Life in itself is a boon only as an opportunity to perform a task, to accomplish a certain work, to actualize an ideal. The aim of life is its significance, and that alone establishes its worth. By having an aim that is rooted in eternity, we need not mind the transiency of life. We can make it a revelation of imperishable ideals, and can impart to life a significance that is beyond the intrinsic meaning of the moment, and possesses a worth everlasting. To attain that worth everlasting is the aim of man's life. That is our immortality and in it we join

"The choir invisible
Of those immortal dead who live again
In minds made better by their presence."

* * *

Professor Fechner's favorite idea consists in the theory that this life to come of man is accompanied by an individual consciousness, and his assumption is based on the fundamental doctrine of psychophysics which proclaims the parallelism of psychic and physical processes.

The theory of psychophysical parallelism is practically accepted by modern science, though some objections have been raised to the word "parallelism" because, as has been said, we have not to do with two parallel series but with one process which allows two aspects, and the parallelism

is not one of reality but merely one of two abstractions. Be that as it may, we will grant that the theory if properly understood need not be regarded as dualistic and we do not hesitate to accept it in its main outlines.

According then to the theory of parallelism, feelings are the inner or psychical aspect of what in the outer or objective world appears as a cerebral commotion, and we observe that only those cerebral functions rise into consciousness which rise above a certain degree of intensity called the threshold (*limen*) of consciousness. But those nervous processes which are too weak to be felt are none the less real and effective in the whole system of our psychical activity. And we must assume that even inorganic nature is accompanied by some element of internality or subjectivity which in its climax corresponds to our consciousness. We have called this weakest group of mere subjectivity, potential feelings, and declared that all reality consists subjectively of such potential feelings which, wherever they assert themselves by action, are felt to be material bodies. Everything that exists is, subjectively, feeling or potential feeling; objectively, materiality or bodily existence. From within and to introspection we are soul; from without and to observation of others we are concrete bodies. (For further exposition see the author's *Soul of Man*, especially the first chapter, "Feeling and Motion.")

Now Professor Fechner claims that the parallelism cannot be limited to our bodily system but extends over the whole world—a consequence in which we follow him, and which, as just explained, is but the matter of obvious consistency. But he goes so far as to declare that the pure relations which obtain in other conditions are as much accompanied by consciousness as are the functions of our brain. To him the totality of the earth is an ensouled body and in addition to the consciousness of individual

beings that live on its surface, it is possessed of a soul of its own. The creatures that people the earth are comparable to nerve-cells of a human body and though every cell in our brain has a life of its own, the whole brain has a superadded consciousness which pursues its own plans and purposes. So, argues Professor Fechner, the earth is a living creature, a kind of super-personal being endowed with a peculiar consciousness in which we unconsciously participate. The same is true of other planets and of the universe as a whole, the spirit of the universe being God.

I will grant to Professor Fechner that the realities which constitute the character of the earth as a peculiar type of existence distinct from other planets are real and efficient but I would regard it as fantastical to look upon the sum total of those realities as ensouled beings—at least ensouled in the human sense, which is the commonly accepted meaning of the term. I deem it a pleasant allegory which will drive home to us the significance of these great interrelations of nature and the universe, and will serve as an evidence that they are by no means nonentities or negligible quantities. Goethe personifies the earth spirit who appears to Faust and characterizes himself in these lines:

"In the tides of life, in action's storm,
A fluctuant wave,
A shuttle free,
Birth and the grave,
An eternal sea,
A weaving, flowing
Life, all-glowing,

Thus at Time's humming loom 'tis my hand prepares
The garment of life which the Deity wears!"

But the personification is not to be taken seriously. Otherwise we would have to look upon the gods of Greece as real personages endowed with life and consciousness. We do not deny that wisdom is a reality though Athene,

the goddess of wisdom, is a mere personification, and though we would insist on the importance of the idea represented by the goddess. The same is applicable to all ideals of life whether or not they have been personified, and it is the main burden of our message to the world that these purely formal relations are the most significant realities of life.

Here then is our agreement with, and difference from Professor Fechner's theory in a nutshell. With him we believe in the reality, the significance, the all-importance of man's life after death, but we regard his description of the part which consciousness plays as misleading. We can not doubt, at least in many cases, that the personality of a man remains centered around his name, and continues to constitute a unit of its own. Yet the nature of this unit is not the same as the unity of a living person. It is purely spiritual and not physical—not physiological. Professor Fechner seems to regard man's being as endowed after death with the functions of the entire nervous system, including the sense-organs and the brain, for which assumption there is not the slightest warrant in ascertainable facts.

EDITOR.

A SCIENTIFIC SKETCH OF UNTRUTH.

THE chief object of this article is to show untruth in its general relations to scientific principles: its origin, necessity, utility, justification, and limitations; how it arises in the human brain, and how it affects human progress. In previous publications I have submitted views on kindred subjects, viz., *The Scientific Basis of Morality*, (Sonnenschein, 1899); "How the World is Governed," (*The Empire Review*, February, 1903); "The Coming Scientific Morality," (*The Westminster Review* and *The Monist*, April, 1904); "A Scientific View of Consciousness," (*The Monist*, April, 1905); "How Universal Energy Governs Mankind," etc. In these publications I have adduced evidence to show that the rudiments of our thoughts and actions can be traced down and merge into the properties and changes of the material elements of which we and our environments are composed. In consequence of the complexity and comprehensiveness of the subject the present article requires attentive reading.

I. GENERAL SCIENTIFIC RELATIONS OF UNTRUTH.

By the terms "truth" or "knowledge" I mean ideas which are consistent with all known facts and with all conclusions properly drawn from them; and by "untruths" I mean statements which are not consistent with facts. That is not knowledge which is not true. It is a strict rule in real science to limit belief to the evidence, and to

exclude all inconsistent ideas, otherwise truth could not be attained, but our mental faculties are so weak and our lives are so short that in ordinary affairs this rule is often disregarded. The human brain also is so constituted that it retains almost any impression, whether true or false, which is strongly made upon it, and we therefore often believe, though we do not really know that which is untrue. The mere antiquity of a belief is not a proof that it is either true or permanent, the ancient one that the sun moved around the earth is an example.

Next to life itself truth is our most valuable possession. As mere belief is often treated as truth, multitudes of persons are willing to suffer almost any pain for the sake of their beliefs, whether true or false, and under this influence many have sacrificed their lives as martyrs, missionaries, explorers, and discoverers. The chief explanation of this fact is that a strongly-fixed cerebral impression is part of the nervous structure, and like a mark of small-pox, is constantly renewed as it wears out. The strength of some fixed beliefs is so great that under their influence thousands of innocent witches and heretics have been slaughtered and burned alive by believers in unprovable dogmas. In consequence, also, of the incessant action of our environment upon us, our love of pleasant falsehoods is so strong that new ones are frequently invented to gratify us. The extent to which we accept and practice untruth indicates the degree of uncertainty of our ideas, and the limits of our love of truth.

As truth and untruth are ideas almost wholly confined to human beings, they are only manifested by an extremely small portion of nature; but they seem large and important to us because they affect us so personally. Science has proved that we are mere specks of matter in the cosmos, animated by its all-pervading motion; we come and go, but the world continues, and we only possess anything for

a lifetime, a mere speck of eternity. Each man perceives only a very minute portion of nature, and understands immeasurably less, and the more ignorant he is the more familiar he assumes to be with the greatest mysteries. The comparative unimportance of man in the universe is shown by the extent to which he is sacrificed by great natural actions, such as earthquakes, volcanic outbursts, hurricanes, diseases, etc.

The human brain is only partly developed, and our intellect is so weak that in nearly all complex questions such as that of morality, we are often compelled to guess conclusions, and this is especially the case in apportioning punishment or reward. The extreme feebleness of our senses and reasoning-powers, even with the aid of scientific appliances, limits nearly all our ideas. There is consequently a maximum of knowledge beyond which we cannot attain, and all additional unknown truth is to us an infinite void. A photographic surface is in this respect similar to the human brain, in that all beyond a small portion of the solar spectrum makes no image upon it, and is to it an entire blank. Further, as we estimate nearly all things by our own little selves, the pains we endure prevent our taking a true view of our position in nature, and the immense amount of human misery around us blinds us to the fact that untruth and pain are largely necessary to human progress and development. In addition to the very limited power of our intellect, and the inconceivable vastness and complexity of nature, nothing is either fixed, final, or quiescent; all things are moving, our mental condition is always changing, and it is largely in this way that many enquirers after the truth, especially in psychical questions, are baffled in their researches, they cannot realize all the possibilities of error. Varying degrees of probability also limit all our thoughts, and we cannot venture safely beyond them.

In addition to these causes of untruth, very few persons think alike except in well-verified science; there are also two or more different aspects of every moral, social, and political question. It requires broad views as well as narrow ones to get through life safely, the narrow view is—"this is a wicked world," whilst the broad one is—"whatever is must be, under all its conditions and circumstances." Nature is full of seeming contradictions, but has no real ones, and we are compelled by our environments to believe both truth and untruth. Our capacities of receiving truth and untruth depend largely upon the properties of our nervous system; thus, dullness of the senses considerably prevents cerebral impressions. In interpreting such impressions, we are usually actuated more by feeling than by reason because our environments act first upon the senses, and only through them upon our intellect, and power is lost in the process. Our feelings are our first guides, and act automatically. We imagine both truthful and untruthful ideas spontaneously to a very large extent; and there are many persons who live almost entirely automatically, without the help of much knowledge or intellect. It is not so much because an idea is true or false that we fail to accept it, but because the brain is unprepared to receive it, or because it contradicts our previous ideas and confuses us. The ability to receive truth depends largely upon the kind and amount of knowledge already possessed, thus he who does not know the alphabet cannot read; similarly, unscientific persons cannot readily accept the scientific basis of morality.

Notwithstanding that untruth is regarded as a species of "sin" to be "stamped out by means of religion," do what we may, we cannot prevent our environments producing it, nor alter the principles upon which the universe and mankind are governed, and which lie at the root of the matter. The only effective preventive of untruth is the

gradual discovery and diffusion of truth, and this can only take place at a very slow rate, because rapid improvement of human beings is more than they can bear.

An extensive examination of books and articles in reviews, etc., on moral and theological subjects, shows that the entire topic of "untruth," "sin," and "evil" remains even now a tangled mass of vague complex statements, which no man can clearly understand. Nearly all such publications are largely written as if the fundamental powers and principles of science have no existence and exert no influence upon man's moral ideas or actions. This is largely due to the difficulties of the subject, and to our feeble apprehension of fundamental science—a special professorship of the chief principles of science in each university might perhaps help to remedy this omission. To live without adequate knowledge of the powers which govern the universe and mankind is largely to "live without God in the world"; but we have little choice in the matter.

In some exceptional cases even clever scientific men seem to lose their reason when they attempt to harmonize science and dogma. Thus Faraday, when asked how he could believe theological doctrines inconsistent with science, replied, "I prostrate my intellect." It is, however, a conspicuous fact that nearly all of the thousands of able scientific discoverers have avoided such subjects, largely because of their confusing nature, and especially because of the great number of untruths and inconsistencies associated with them. The attempt to harmonize science and dogma is nearly always a failure, and whilst we may consider unproved statements as such, in order to test them, we cannot with safety fixedly believe important ones without proper and sufficient evidence, and if the evidence is insufficient we must wait for more.

Inconsistency is a degree of untruth and often a first

sign of insanity; no man can believe in dogmas, miracles, ministering angels, the existence of spirits in space, life or mind without matter, etc., and at the same time in the fundamental principles of science, without suffering cerebral confusion, because the two sets of ideas are contradictory. A proof that the methods employed by scientific discoverers, viz., experimental observation, meditation, and inference, are reliable, and those used by supernaturalists are not, is the fact, that whilst tens of thousands of new truths have been found by means of the former, few or none have been evolved by the help of the latter. The great failure of untruth as a means of discovery does not, however, prove that it is useless or entirely unjustifiable.

2. THE ORIGIN OF UNTRUTH.

Of what is termed the "first cause" of truth or untruth we know nothing, simply because it is beyond the limits of human power:

"Heaven from all creatures hides the book of fate,
All but the page prescribed, their present state."

—Pope.

Any natural action, such as thought, is only one in an infinite series of events, and our perceptive power is altogether too limited to enable us to trace our ideas back to a "first cause" in the infinite past. The deepest cause, both of truth and untruth, so far as we can at present trace it, is the universal motion within and around us, which is always acting upon our cerebrum and producing impressions. Physicists well know, from the phenomena of astronomy, spectrum-analysis, heat etc., that all substances, whether living or dead, are in this state of perpetual and indestructible motion; and that this motion acts upon all things by means of radiations through the ether. It acts upon men, and compels each man to influence his fellow-man, and his fellowman to influence him.

The origin of untruth depends further upon the fact

that all bodies, whether living or dead, have but limited powers, and that the intellect of man can only imperfectly distinguish truth from error; this human feebleness is largely due to the small range of the senses, the immensity of the universe, and the almost infinite complexity of nearly everything in it. The smallest irregularity, or weakness of action of the senses or intellect, also produces false ideas, and it is largely in this way that untruth and "sin" enter the human brain. A multitude of untrue impressions arise from the circumstance that we magnify the importance of everything we feel, and pass unnoticed the greatest of truths if they do not affect our consciousness. Even the life-supporting substance, oxygen gas, was not discovered until the year 1774.

It is well known that truth is mingled with untruth in every person, but it is not so obvious that the essential source of each, viz., the impressions produced upon the brain by the motion of its environments, is the same in all. The result produced is either truth or untruth according to the kind of cerebral impressions made and of those already present. If the incoming ideas are true and the brain is properly prepared, truth is received; but if either the new ideas are false, or the brain is unprepared, untruth is produced. Many impressions are made upon our brains without our perceiving them, and are occasionally revived in our dreams. They are often untrue because our intellect is not sufficiently awake to correct them. In consequence of differences of perceptive ability and of existing impressions in different persons, that which appears true to one person often seems untrue to another, thus the dogma of "The Immaculate Conception" appears true to Roman Catholics but is utterly false to physiologists and scientific men generally.

The reception or rejection, both of truth and of untruth is largely dependent upon the intellectual state of the brain

Thus boys and girls are not admitted into higher-grade schools if they have not been properly prepared in lower ones; similarly, the brain of each person must already contain a sufficient number of true ideas suitable to correct the incoming ones by means of comparison and inference. It is largely through deficiency of truthful impressions and of suitable training, that ignorant persons are frequently untruthful. The universe is infinitely truthful, and the chief sources of untruth are in us. The greater the number of important truths we know, the smaller, usually, is the proportion of untruths we believe, because each important truth corrects and weakens some untruths. We are immersed in an unlimited ocean of mysteries, and in consequence of our very limited faculties, we believe a multitude of untruths respecting them.

The reception and rejection of truth and untruth are also largely dependent upon sensation and feeling. As our environments act first upon our feelings, and only secondly upon our intellect, the way we receive our impressions is usually decided by the feelings; if these are pleasant they are accepted, and if painful they are rejected. The ordinary automatic excitement of our brains, uncorrected by evidence and intellect, is a great source of untruth; thus we spontaneously imagine all kinds of false ideas. We fancy that we are stronger than nature, because of our numerous discoveries and inventions, forgetting that it is the energy of our surroundings which causes us to make these discoveries, and that nature has vastly more power over us than we have over it. We imagine that a "spirit" or an "ego" within us draws our conclusions, whilst the fact is, our conclusions are produced by the influence of the evidence and of our feelings upon our intellect, the cerebral impressions automatically causing the inferences by the aid of comparison. We fancy that our volitions are due to the "ego," not thinking that they may be produced

by unobserved stored-up cerebral motion. It is only by automatic action and re-action, accompanied by transference of energy, that we to a small extent "govern nature" by our volitions;—similarly, in our ideas of "choice, selection, and self-guidance," we overlook the fact that we are automatically compelled to perform them. It is well known that metals automatically "select" particular metals from mixed metallic solutions, and that crystals automatically "choose" pure ingredients from impure saline liquids with which to build up their structures, and therefore a mysterious "power" is not necessary to perform the same kind of work in us. Energy is always stored up in us from our food, and liberated under suitable conditions, and the so-called "soul in atoms" and "mind in plants" are probably different modes of motion in those different bodies. Neither the sun, nor universal energy is a "divinity," simply because it guides and governs terrestrial and heavenly bodies.

Some persons believe that "ministering angels" and beings of a higher order than man surround us, that vitality exists independent of matter, that space is tenanted both by human ghosts and vital ones, by spirits of dead plants and animals. But we do not possess satisfactory evidence which proves that these ideas are true; and such beliefs would be prevented by adequate knowledge of physiology. The radiation images emitted by substances, and which travel 186,400 miles a second, cannot be permanent spirits, because they are transformed, and cease to exist, when they fall upon other bodies. Another common error is that human thoughts and actions are "guided" by some "spiritual power" outside them, but the discoveries made by Newton, Joule and others, of the planetary movements especially, have largely proved that the universe is a self-guiding machine; that the energy in each act of change passes automatically from one substance into another and is altered in its form in the process, but without perceptible

loss or gain in total amount. Therefore there is no work left for "spiritual power" to perform. Such spiritualistic hypotheses are too complex and vast to be proved by mere human observation alone, they require a variety of well-verified evidence. Nothing less than the incorrupted testimony of inanimate substances, such as are employed in physics and chemistry, would be sufficient to fully justify us in firmly believing such important and extraordinary statements; and we must wait patiently for such evidence respecting them as Newton waited for Picard's measurements to prove the truth of the law of gravitation. The number and variety of forms in which untruth automatically arises in the human brain is practically endless, but the instances given are sufficient.

Suitable knowledge of science enables us to detect the rudimentary causes of nearly all our chief actions in plants, and even in minerals. Magnets and metals show distinctly the rudiments of heredity and of memory, and crystals show those of "choice" and "volition." Man is not the only deceiver, many other animals deceive, and although inanimate bodies do not actually utter untruths, their properties and actions suggest them. Thus the sun, during all ancient time appeared to revolve round the earth, until astronomers discovered the deception; and the weather is notoriously deceitful. The rudiments of various "moral and immoral" qualities in plants have been described by J. E. Taylor in his book *The Sagacity and Morality of Plants*. The statements made respecting the existence of "souls in atoms" and "mind in plants" are largely instances of incorrect nomenclature. Calling things by false names is common practice, and energy is not "mind" simply because it is motion.

Untruth is often an immediate result, either of ignorance or design. Many serious untruths have been invented and promulgated at different periods. Those of

the existence of a "heaven," a "hell," a "devil," and "immortality of the soul" are very ancient; that of "transubstantiation" was invented in the ninth century, that of the "Immaculate Conception" was made an article of faith in 1854; and the "Infallibility of the Pope in faith and morals" was decreed in 1870; and some persons even now venture to assert that "the value of a single soul is infinite." Untruth is greatly promoted by human conceit; in consequence of the incessant action of our environments upon our senses and feelings, the importance of everything human and personal is exaggerated. Thus we consider that "the universe was made for man," whilst it is incomparably more true that man is merely a denizen and an extremely minute fraction of this little globe. It is altogether beyond human power to adequately perceive its own littleness in the cosmos. The universe is one of truth, and the cause of our inability to truly explain it lies largely in us; we are simply deceived because we are ignorant. It is chiefly in consequence of the inconsistency between ordinary narrow views and comprehensive scientific ones that the entire subject of "sin and evil" is a vast paradox to unscientific persons.

3. THE JUSTIFICATION OF UNTRUTH.

Absolute compulsion justifies all things, even the immense destruction of human beings by great terrestrial catastrophes, epidemics, etc., and no exceptions are made in favor of men, whatever their sufferings or beliefs may be. The supreme question throughout nature is, not what is most truthful or pleasing to mankind, but what is most necessary to the well-being of the universe, and everything which tends to this. The first effect of universal natural energy is to preserve the cosmos, and this is the greatest good; because all other good things depend upon it; if this world were destroyed all mankind would perish with it.

"The first Almighty Cause
Acts less by partial than by general laws."
—Pope.

"Better for us, perhaps, it might appear,
Were there all harmony, all virtue here;
That never air or ocean felt the wind,
That never passion discomposed the mind,
But all subsists by elemental strife
And passions are the elements of life."
—Pope.

With every living thing there is action and re-action; life is a struggle and a conflict. The fox gains a living by means of deceit, and the incomes of many men and women are largely secured by means of untruth and unceasing competition.

The strongest power governs in nearly all cases; the stomach must be fed before the intellect, because it is the stronger influence. Our most pressing question usually is, not what is true, but how can we live and enjoy life. We are primarily governed by infinite energy, and our thoughts, whether true or untrue, are as necessary consequences of natural powers as the actions of inanimate substances. We possess no full proof that an act of thought is in any case an exception to this, but we have abundant evidence to show that our ideas require expenditure of natural energy to produce them. The formation of each truth or untruth in the brain is attended by consumption of heat. Each single idea also arises out of its immediately preceding cause, in accordance with the principles of continuity and equivalency of energy. We all think and act as we are compelled by our environments, and we cannot much prevent them forcing us to believe untruth as well as truth.

An opinion has long been held, though rarely expressed, that there exists some degree of justification of untruth, and this unpleasant conclusion is largely supported by evidence. Thus the simple facts that untruth

is a necessary consequence of the action of our environments upon us, and that each man thinks as he is compelled under all his conditions and circumstances, are alone sufficient to prove some degree of justification for it. The opinion is further supported by the fact that truth and untruth are essentially alike. Thus both are cerebral impressions caused by natural influences; each is limited by circumstances; each supplies pleasures and pains, consolations and disappointments; each is necessary to human progress; the use or abuse of either is rewarded or punished; and we justify each so far as we think it does good. There are all degrees of truth and untruth. Each has opposite effects according to its amount, so that if either is deficient, it does not sufficiently stimulate us to action, and if in excess it excites us too much. Both are governed by the influence of our environments, and are kept within certain bounds by their conditions. A due amount of truth promotes human progress, a deficiency fails to stimulate it, and an excess retards it by producing too rapid a change. Untruth aids progress by exciting conflict and discussion and retards it by misleading mankind.

There are, however, conspicuous differences between them, and although these are of very small value in the cosmos, their highly personal effects cause us to feel them keenly, and to exaggerate their degrees of importance. The chief ones are that truth is reliable, whilst untruth is not; truth is a safe basis for thought, prediction, and action, but untruth is always liable to be detected, refuted, and rejected; we cannot reliably predict future events from untruthful data; truth leads to new knowledge and scientific discoveries, but untruth does not; truth is consistent with all known facts, but untruth is not; untruths are often cheap at the outset, but dear at the end; while truths are the reverse. Truth is far superior to untruth as a guide of life, and as a consolation in times of distress, be-

cause it is trustworthy and unalterable. It is, however, much more difficult to obtain. The reliability of a man's word is largely proportional to his freedom from untruthful beliefs, because they prevent the reception of truth; and to his knowledge of the great principles of science, because they are the chief tests of truth and error. True views of nature and of human conduct yield the most permanent happiness. It is largely in consequence of deficiency of such knowledge that untruths are believed and propagated by many of the kindest men. Truth is the best stimulant to self-improvement. The acceptance of it is largely a question of education and training, and of how much self-sacrifice and labor a person is able to bear. Whilst truth imparts courage and self-reliance, the uncertainty of untruth weakens all our powers. Whilst too much truth is more than ignorant persons can comprehend, too much untruth is more than intelligent ones can bear, whence arises continual conflict between these two sections of mankind.

Untruths are fundamentally mere temporary expedients in the evolution of man. They are often unhealthy and a first step to insanity, and as untruthfulness often leads ultimately to suffering, we should be as careful about what ideas we accept as we are of what food we partake, and adopt similar general rules in accepting them. In consequence of untruth and ignorance, millions of persons are annually led into disease, misery, crime, insanity and early death; and it is only on acquiring sufficient knowledge of the chief powers and principles which govern the universe, and referring all questions to them for explanation, that untruth can be prevented from entering the human brain. Untruth is not accepted if we are trained well and possess, in advance, the knowledge necessary to correct it. But to entirely prevent it is impossible because that would require unlimited knowledge; the utmost we can do is to

correct and slowly diminish it. As all our attempts at avoiding it are extremely feeble in comparison with the magnitude of the task, we go on much in the same way from one generation to another. All mankind cannot be suddenly made truthful, and even if they could, each generation would still require teaching afresh. Belief in untruths generally must continue as long as mankind remains ignorant of the chief principles of science. Untruth, conflict and strife are inseparable from human life. Conflict is a result of motion; the whole of nature exhibits it, thus waves beat upon rocks and wash them away. All nature appears deceitful, but the real source of deception is usually the feebleness of our faculties.

Notwithstanding its drawbacks, untruth is a cosmic and human necessity. It is necessary as an element in the general evolution of man. We are in a state of gradual development, and require some stimulus to compel us to change. Truths and untruths, pains and pleasures stimulate us; they strengthen us if accepted rightly and are not too great for us to bear, and weaken us if in excess. The facts also that untruthful expressions are produced by the same natural process as truthful ones, and exist in accordance with the law of universal causation, are alone sufficient to prove their necessity. There exists some degree of virtue even in untruth, but our views are so narrow we can hardly believe it, thus, in common with other kinds of "evil" it is useful as a regulator of human progress. As deadly poisons, such as arsenic, prussic acid, and strychnine, are sometimes necessary to relieve disease of the human body, untruth may in some cases be necessary and justifiable to relieve distress of the mind. Through lack of knowledge and courage we frequently consider pain and untruth to be "evil" when they are not. The idea that truth and untruth are really evil when they produce pain, will not bear examination; the universe does not exist

merely for our pleasure, but we exist to obey omnipotent power. A large portion of the pain of life arises from our ignorance and false ideas, and another from great natural causes over which we have but little or no control, and all animals have to submit to it.

According to the widest scientific knowledge "whatever is, is right," but according to ordinary narrow ideas "this is a wicked world," and "there is something wrong in everything"; but even this dissatisfaction is useful because it excites discussion and stimulates change and progress. Untruth is only one form of a multitude of actions we term "evil," but according to science all these actions, ranging from the greatest physical catastrophes to mere exaggeration in men, are ultimate results of physical powers, and men are as perfect as the fundamental properties of the bodies of which they are composed allow them to be. Man is not imperfect because he is complex; a complex ocean-steamer is as perfect as a simple sailing-ship. Nor is he "sinful" because he is weak; his "sins" and the actions within and around him, arise out of the facts that all substances and creatures act, or fail to act, upon each other, according to their natural properties.

"Then say not man's imperfect, Heaven's at fault,
Say rather, man's as perfect as he ought."

—Pope.

and that when all is known and all is understood, mankind will see "whatever is, is good," and that man is working out his destiny by means of untruth and of truth.

Untruth has often more adherents than truth in complex subjects, chiefly because false explanations are frequently more pleasing or easily understood than true ones; and the question what is justifiable in any complex case, is never finally settled to the satisfaction of all persons, simply because very few persons think alike in complicated subjects. Nearly all persons practically support by their

conduct the conclusion that untruth is more or less justifiable. The amount of pleasure and stimulus afforded by it in tales, novels, plays, poetry, suggestive music, oratory, sermons, allegories, metaphors, dogmatic beliefs, miracles, pseudo-science, etc., is immense—the popularity of Bunyan's *Pilgrim's Progress* and *Robinson Crusoe* are familiar examples. And the consolation afforded by theological dogmas to millions of persons in distress or near to death, is abundant proof of its immediate utility, whether it is fully justifiable or not. The chief explanation of these facts is, that we are largely compelled to tell untruths by the influence of circumstances upon us, and because it is often a habit or personal advantage. It is of great use in helping us to acquire money, social influence, popularity, and success. A vast amount of it is employed in nearly all occupations, in trade, manufactures, literature, social appearances, sectarian teaching, etc.: it has been used to an immense extent in all ages to satisfy the almost universal desire for pleasure, even the prophet Jeremiah is reported to have said, "the prophets prophesy falsely, the priests rule by their means, and the people love it to be so"; and as untruth is so useful, it necessarily continues. Most persons tell untruths spontaneously, as far as they think it is for their advantage, as far as they dare, and as other persons allow them; and all are more or less occupied in defending themselves from the untruth and deceit of their fellows.

The same universal energy which produces changes throughout nature, compels us to use both truth and untruth in securing a maintenance. As life is and must be our first object, and untruth is so necessary in obtaining an income, we may not entirely condemn those who practise or diffuse it, but there is a limit to its justification, and whilst we should be tolerant towards others, we must protect ourselves from injury, both by untruthful persons, and

by advocates of too rapid advance; we require to be duly altruistic towards all men, and sufficiently conservative towards ourselves. Absolute necessity largely justifies the conduct of a criminal as well as that of the judge who condemns him to punishment. Persons are blamed and punished, not so much for their misdeeds as to deter them from doing wrong in the future. The fact that untruth is more or less necessary, justifiable, and good for mankind is one of the many painful truths we have to accept, whether we are willing or not. Similar arguments justify in various degrees all that we term "sin and evil."

The real scientific justification of an act is the degree to which it contributes to the welfare of the cosmos, therefore to that of all men, and not alone to our personal pleasure. The well-being of the universe, and "the greatest good" are nearly synonymous, and the noblest object of life is comprehensive utility. There are all degrees of "goodness," and that which does good, is more or less good whether it be a truth or an untruth; and the larger the "good" and the less the "evil" produced, the greater is the degree of justification. But "good in excess is evil," and extreme pleasure is painful. An excess of truth or of pleasure is more than some persons can bear, and much of the cheap goodness extant is hardly worthy of the name. There exist nearly all degrees of justification of untruth, ranging from that of automatic unintentional exaggeration to that of serious manifest falsehood. Such automatic falsehood is very prevalent, is often acquired by habit, and is a frequent sign of ignorance and defective training. But if some persons did not readily exaggerate the importance of money and pleasure they would not be sufficiently stimulated to obtain it, and if others did not over-value new knowledge they would not make the sacrifices necessary to discover it, and human progress would be impeded. As also the brains and nerves of different persons require

different degrees of stimulation to excite them, exaggeration is in some degree useful. In consequence of our very limited intellect in complex cases, some persons practice expediency and try to "appear all things to all men," but even this is a degree of untruth, and has some justification. It is only by faith in the greatest truths that we can be fully justified, and the most final court of appeal is consistency with all known facts.

How far untruth is justifiable in any particular case depends upon the circumstances, and as we cannot actually measure the value of these, we are only able to guess a reply, and act upon the degree of probability, and every different person guesses differently. This difficulty is usually diminished by employing juries, committees, etc., on the rule that "in a multitude of counsellors there is safety." Such cases are almost endless in number and variety, and give rise to continual discussion without arriving at any final conclusion. Justification of untruth is largely a personal matter which each man must decide for himself and accept the consequences. The practice of untruth, even for laudable purposes, lessens respect, because it shows our feebleness; and how far it is justifiable to believe and teach unprovable statements in important subjects is a serious question, and requires frequent revision as civilization advances.

4. LIMITATION OF UNTRUTH.

The general restrictions of untruth are much the same as those of truth: viz., how much our environments ~~compell~~ us to accept, and how much we are able to bear. As the properties and powers of nearly everything are limited, this restricts the effect of our surroundings upon us. Too much truth stuns us, and too much untruth repels us, and each excites our resistance. The untruthful man does as he must, and his victims do as they must in return in order

to protect themselves and restrain his conduct. The fact that both truth and untruth are kept within bounds by our feelings, shows that they are governed and limited by the stronger influence of our environments. Everything limits the action of everything of opposite property. Truth and untruth limit each other; intelligence and ignorance, ditto; the same with science and dogma; and with the advancing and retarding sections of mankind; we cannot simultaneously think of two opposite ideas; and even a Deity could not be infinitely just and infinitely merciful. Both truth and untruth are limited by rules of social conduct. Ordinary social life could not be carried on if untruth was too prevalent, or if too much new truth was suddenly made known. If ignorant persons had too great power there would be no supply of new knowledge and no human progress; and if the most scientific had too much control, the labor of self-improvement cast upon ignorant persons would be more than they could bear, even now millions of persons fail prematurely in the struggle of life. All these phenomena depend largely upon the great fact that every action requires time, and is almost wholly determined for us by natural powers.

Untruth in any subject usually lasts only as long as mankind is pleased or benefited by it. Old habits and false ideas die out; the dogma of all things being composed of "earth, air, fire, and water" has disappeared, and others are following it; even the view that the elementary substances are wholly inconvertible is being modified, for we now know that some of them change into others with extreme slowness. The use of truth is restricted in various ways similar to that of untruth; thus it may not be told at all times to all persons or under all circumstances; and if it is said with malicious intent, and not for public advantage, it becomes libel; untruth in cases of perjury is criminal. We must not use either truth or untruth so as

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growth, maintenance and decay. Food and friends support us, whilst poison and enemies kill us. The different influences act through our feelings of pleasure and pain; thus, through that of pleasure we are stimulated to desire more progress, and through that of pain we are compelled to avoid or diminish it. And in order to accomplish these objects we are driven to seek new knowledge; in this way, whilst our present information maintains our present state, scientific research evolves new knowledge for advance.

We only advance as fast as we are impelled. The rate of general progress is probably as certain and definite as that of the earth in its orbit, but owing to the immense complexity of the phenomena, and the limited extent of our powers, we are unable to measure it. The rate depends upon the fact that every action requires time; and upon the ability of the human body and brain to bear change. It is usually increased by truth, and decreased by untruth. It is largely regulated by the incessant conflict of the intelligent and the ignorant; whilst the former originate new knowledge and invent new applications, the latter prevent too rapid change. In accordance with the principle of equality of action and re-action, conflict is a part of our existence, and believers in truth and untruth constantly restrain each other. Untruth has two opposite effects upon human progress according to its strength; thus, if its strength is deficient, it fails to retard it, if in due amount it produces conflict and competition, and if in excess it retards progress by exciting too much resistance; an excess of new truths upsets our arrangements, and it is well known that although we cannot measure goodness we may have "too much of a good thing."

The greatest exception to the use of untruth is original scientific research; this occupation stands alone as the search for truth by reliable methods. Whilst untruth is entirely forbidden in it, unlimited faith in unproved state-

ments is insisted upon in theological teaching. In all real scientific research, dogmas and hypotheses are treated merely as questions to be tested. Its reliability is practically shown by the success of its predictions, and by the variety of ways in which the governments of civilized nations depend for advice upon scientific societies; and its extent is partly shown by the titles of hundreds of thousands of costly researches contained in The Royal Society Catalogue, eleven volumes of which, costing more than £10,000 have already been published.

6. CONCLUDING REMARKS.

The principles set forth in this sketch constitute a scientific basis of morality, and offer great scope for application in explaining the evolution and government of mankind; they enable us to distinguish truth from error in a multitude of complex cases, and are capable of rationally explaining "sin and evil"; they form the truest philosophy and supply the safest consolation in periods of distress to those who can comprehend the subject, because they are consistent with all known facts. Their practical applications are very interesting, because they affect all men, and every act of human conduct. A fixed belief that all persons are governed by universal natural causation, and "do as they must under all the conditions and circumstances," requires us to forgive our enemies; and a full conviction that the most moral rule of conduct is "to do the greatest good," compels us to remember their actions, because knowledge is necessary for our guidance and defence. In this way, whilst knowledge of the great principles of science increases toleration of "sin," it also increases obedience to law, and excites a due amount of conflict and progress. Even the valuable Confucian injunction, to "do unto others as we would have them do unto

us" is not as correct as science requires, because it does not take into consideration the fact that what we would have done unto us may not be "the greatest good" for others.

The whole of the evidence supports the common opinion that it is largely beyond our power to devise a better system of nature than that which already exists, and which causes our evolution as well as our existence.

G. GORE.

BIRMINGHAM, ENGLAND.

CRITICISMS AND DISCUSSIONS.

HAECKEL'S THESES FOR A MONISTIC ALLIANCE.*

Professor Haeckel has written a series of theses, which are intended as a confession of faith for all those who would embrace a scientific world-conception, and take a firm stand on monism as contrasted with the traditional dualism of dogmatic Christianity and kindred religions of the past. He thinks that the time has come for all monists to form a great monistic alliance and these articles are intended to serve as the standard around which they should rally. Unfortunately the theses are so contentious that they must be irritating to the large masses who, though they are willing to follow science wherever it may lead, have not yet renounced their allegiance to the old religious ideals; and though willing to discard any errors of dogma or tradition, do not propose to surrender whatever good there is in religion.

It is further unfortunate that the formulation of the outline of the scientific world-conception is rather slovenly and made with no due precaution. For instance, the term *a priori* is introduced and expressly referred to Kant. Apriorism, as well as all assertion of metaphysics, is rejected and Kant's name is put in parentheses to leave no doubt as to whose philosophy is meant. This is done in spite of the fact that Professor Haeckel is very familiar with Kant's philosophy, to which he devotes a special chapter in one of his later works. He should have borne in mind that Kant's doctrine of the *a priori* is quite in keeping with a scientific philosophy in the more rigorous sense of the word, and that Kant's metaphysics

~~is not~~ Haeckel's confession of faith, entitled *Universal Monistic*
~~is not~~ *the Organisation of Monism*, was presented before the
~~is not~~ Congress of Freethinkers at St. Louis, Mo. A revised edition
~~is not~~ then under discussion has been published by The Humani-
~~is not~~ ty Society, 252 East Lee St., Los Angeles, Cal.

ics should not be confounded with the metaphysical systems of many of his interpreters and followers.¹

In a similar way I take exception to his doctrine of determinism which excludes the possibility of free will.² I object to his treatment of the origin of man as being descended from the ape.³ Presumably we agree as to facts, but we differ as to the propriety of the mode of presenting them. I am further not satisfied in having the oneness of nature limited to biology and physics, as if the realm built up by man (who with all his wealth of moral ideals and scientific attainments is simply characterized as a social *animal*) were a mere and insignificant variation of biological phenomena.⁴

But in addition to the carelessness with which these thirty theses have been drawn up, Professor Haeckel commits another mistake almost more grievous. He speaks of divine revelation as being based either upon lack of clearness or intentional fraud, a theory much in vogue among the rationalists of the eighteenth century but long since discarded by historians and investigators. He has not as yet learned to apply the theory of evolution to the domain of religion and the history of science. He appears to be unmindful of the fact that ideas pass through definite phases of growth, and that some errors are inevitable because natural, and that these errors contain a truth which has to be sifted from preliminary formulations by a slow process of maturation.

The mythology and dogmatism of the earlier stages of our religious development are not so much errors—let alone frauds—as transitory phases, in the same way that flowers and the unripe state of fruit are essential steps in the preparation of the seed.

Professor Haeckel ought to be the last man to disregard the evolutionary phase in both religion and science; and knowing well that evolution is the dominant law of life, he ought to have shown

¹ Kant's inventory of the *a priori* is practically the domain of pure reason.

² According to my definition, will is free whenever it can act according to its own nature, and not (as others have it) when it can will as it pleases. The contrast is between free will and compulsion, not between free will and determinism. Every act is determined, but acts of free will are determined by the character of the acting person, while acts of compulsion are not. To identify freedom of will with indeterminism is simply a confusion of thought, for there is no sense in the proposition that will, in order to be free, ought to be undetermined—an arbitrary product of chance. There would be no ethics without freedom of will. For further details see *Fundamental Problems*, p. 191 ff.; *The Monist*, Vol. III, pp. 86-87; *The Ethical Problem*, pp. 45-50.

³ See the author's article "The Ascent of Man," *The Open Court*, March, 1904.

⁴ I have discussed Professor Haeckel's position in the second part of a recent article "Theology as a Science," *The Monist*, Vol. XIII, p. 24 ff.

more consideration of and love for the past, which is preparatory to the present and the future. If he had done so he would have been in the churches more that is good and would have endeavored to advance the essential and purify it of its unessential and transient elements.

Having stated our general criticism of Haeckel's theses, there is scarcely any need of entering into further details and pointing out how mistaken he is in emphasizing the one-sided view of the materialism against the traditional conservatism of the churches. Though he appears as an enemy to the existing churches instead of rejoicing in their higher development into a new and truer interpretation of their dogmas, and, though perhaps without meaning it, he introduces into the scientific atmosphere of those of his followers who accept the facts of science rather than its methods, a spirit of iconoclasm which in its extreme became predominant among liberals would be lamentable in the highest degree.

A confession of faith ought to be positive and not predominantly negative. It ought to state what is, or is to be, believed as such to reject the belief of others, unless in very general terms and without entering into details. Professor Haeckel might as well have added to his denunciation of Christianity, a condemnation of the fetish worshipers in the darkest part of Africa, or the superstitions that still prevail in many temples of the Celestial Empire, or especially all modern aberrations of New Thought, Christian Science and Freethought, for there are quite a number of writers who parade under this name and associate unhesitatingly with Haeckel's friends the Freethinkers.

If the time has come for monists to rally under the flag of a common confession of faith, let it be simple and to the point—consisting of a few sentences which casts no slur on either dualism or materialism, and leaves the consequences to be drawn by others from their own principles.

The formulation of a confession of faith, be it for monists, rationalists, or any kindred spirits of progress, depends upon the occasion and purpose for which it is to be made. Under whatever circumstances might lead to it, it seems to be inadvisable that it be limited to a statement of principles, but that it include special results of investigation as much as possible.

One of the points on which monists of every stripe and color are agreed is the recognition of science as the appropriate

method of determining truth. The highest authority in matters religious ought to be the truth, and we deem it our duty to search for the truth with the most rigorous method that science places at our disposal.

P. C.

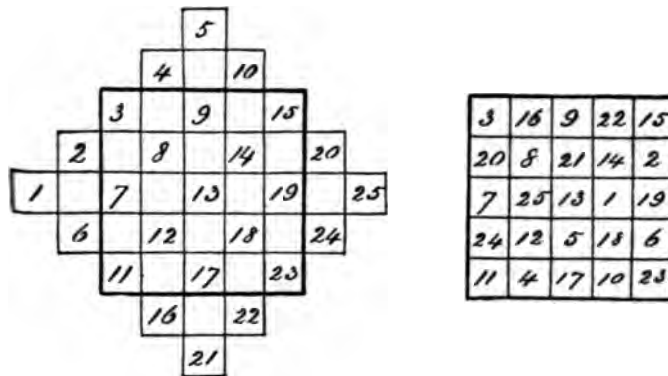
REFLECTIONS ON MAGIC SQUARES.

MATHEMATICAL, HISTORICAL, AND PHILOSOPHICAL.

Mathematics, especially in the field where it touches philosophy, has always been my foible, and so Mr. W. S. Andrews' article on "Magic Squares" tempted me to seek a graphic key to the interrelation among their figures which should reveal at a glance the mystery of their construction.

THE ORDER OF FIGURES.

In magic squares of odd numbers, 3×3 , 5×5 , 7×7 , etc., there is no difficulty whatever, as Mr. Andrews' diagrams show at a glance. The consecutive figures run up slantingly in the form of a staircase, so as to let the next higher figure pass over into the



A SPECIMEN OF 5×5 MAGIC SQUARE.

next higher or lower cell of the next row, and those figures that according to this method would fall outside of the square, revert into it as if the magic square were for the time (at the moment of crossing its boundary) connected with its opposite side into the shape of a cylinder. This cannot be done at once with both its two opposite vertical and its two opposite horizontal sides, but the pro-

cess is easily represented in the plane by having the magic square extended on all its sides, and on passing its limits on one side we must treat the extension as if we had entered into the magic square on the side opposite to where we left it. If we now transfer the figures to their respective places of the inside square, they are shoved over in a way which by a regular transposition will counteract their regular increase of counting and so equalize the sums of entire rows.

The case is somewhat more complicated with even magic squares, and a suggestion which I propose to offer here, pertains to their formation. Mr. Andrews begins their discussion by stating that "in perfect magic squares of this class it is necessary that the sum of each column shall be the same amount, and also that the sum of any two numbers that are geometrically equidistant from the center of the square shall equal the sum of the first and last numbers of the series."

The smallest magic square of even numbers is, of course, 4×4 ; and he points out that if we write the figures in their regular order in a 4×4 square, those standing on the diagonal lines can remain in their places, while the rest are to be reversed so as to replace every figure by its complementary to 17 (i. e., 2 by 15, 3 by 14, 5 by 12, 9 by 8) the number 17 being the sum of the highest and lowest numbers of the magic square (i. e., $n^2 + 1$). It is by this reversal of figures that the inequalities of the natural order are equalized again, so as to make the sum of each row equal to 34, which is one fourth of the sum total of all figures, the general formula being:

$$\frac{1 + 2 + 3 + 4 + \dots + n}{n} = \frac{n}{2} (n^2 + 1).$$

We will now try to find out more about the relation which the magic square arrangement bears to the normal sequence of figures.

For each corner there are two ways, one horizontal and one vertical, in which figures can be written in the normal sequence; accordingly there are altogether eight possible arrangements, from which we select one as fundamental, and regard all others as mere variations, produced by inverting and reversing the order.

As the fundamental arrangement we choose the ordinary way of writing from the left to the right, proceeding in parallel lines downward. We call this "the ordinary order" or *o*. Its reverse proceeds from the lower right hand corner toward the left, and line by line upward, thus beginning the series where the ordinary

arrangement ends, and ending where it started. We call this order "the reversed ordinary," or simply *ro*.

Another order is produced by following the Hebrew and Arabic mode of writing: we begin in the upper right-hand corner, proceeding to the left, and then continue in the same way line by line downward. This, the inverse direction to the ordinary way, we call briefly *i*.

The reverse order of *i*, starting in the lower left corner, proceeding to the right, and then line by line upward we call *ri*. Further on we shall have occasion to represent these four orders by the following symbols: *o* by $\bullet$; *ro* by $\odot$; *i* by $\ddagger$; *ri* by $+$.

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36

ORDER *o* ($\bullet$).

6	5	4	3	2	1
12	11	10	9	8	7
18	17	16	15	14	13
24	23	22	21	20	19
30	29	28	27	26	25
36	35	34	33	32	31

ORDER *i* ($\ddagger$).

31	32	33	34	35	36
25	26	27	28	29	30
19	20	21	22	23	24
13	14	15	16	17	18
7	8	9	10	11	12
1	2	3	4	5	6

ORDER *ri* ($+$).

36	35	34	33	32	31
30	29	28	27	26	25
24	23	22	21	20	19
18	17	16	15	14	13
12	11	10	9	8	7
6	5	4	3	2	1

ORDER *ro* ($\odot$).

It will be noticed that *i* is the vertical mirror picture of *o* and *ro* of *ri*, and *vice versa*. Further if the mirror is placed upon one of the horizontal lines, *ri* is the mirror picture of *o* as well as *ro* of *i* and *vice versa*.

There are four more arrangements. There is the Chinese way of writing downward in vertical columns as well as its inversion, and the reversed order of both. This method originated by the use

1	15	14	4
12	6	7	9
8	10	11	5
13	3	2	16

16	2	3	13
5	11	10	8
9	7	6	12
4	14	15	1

1	63	62	4	5	59	58	8
56	10	11	53	52	14	15	49
48	18	19	45	44	22	23	41
25	39	38	28	29	35	34	32
33	31	30	36	37	27	26	40
24	42	43	21	20	46	47	17
16	50	51	13	12	54	55	9
57	7	6	60	61	3	2	64

1	143	142	4	5	139	138	8	9	135	134	12
132	14	15	129	128	18	19	125	124	22	23	121
120	26	27	117	116	30	31	113	112	34	35	109
37	107	106	40	41	103	102	44	45	98	98	48
49	95	94	52	53	91	90	56	57	87	86	60
84	62	63	81	80	66	67	77	76	70	71	73
72	74	75	69	68	78	79	65	64	82	83	61
85	59	58	88	89	55	54	92	93	51	50	96
97	47	46	100	101	43	42	104	105	39	38	108
36	110	111	33	32	114	115	29	28	118	119	25
24	122	123	21	20	126	127	17	16	130	131	13
133	11	10	136	137	7	6	140	141	3	2	144

EVEN SQUARES IN MULTIPLES OF FOUR.*

* These squares, 4×4 and its multiples, consist of *o* and *ro* orders and it will be sufficient to write out the two 4×4 squares, which show *o* and *ro* are mutually interchangeable.

o	ro	ro	o
ro	o	o	ro
ro	o	o	ro
o	ro	ro	o

ro	o	o	ro
o	ro	ro	o
o	ro	ro	o
ro	o	o	ro

of bamboo strips as writing material in China, and we may utilize the two vowel sounds of the word "bamboo" (viz., *a* and *u*) to name the left and the right downward order, *a* the left and *u* the right, the reverse of the right *ru* and of the left *ra*; but for our present purpose there will be no occasion to use them.

Now we must bear in mind that magic squares originate from the ordinary and normal consecutive arrangement by such transpositions as will counteract the regular increase of value in the normally progressive series of figures; and these transpositions depend upon the location of the several cells. All transpositions in the cells of even magic squares are brought about by the substitution of figures of the *ro*, *i*, and *ri* order for the original figures of the ordinary or *o* order, and the symmetry which dominates these changes becomes apparent in the diagrams, which present at a glance the order to which each cell in a magic square belongs.

Numbers of the same order are grouped not unlike the Chladni acoustic figures, and it seems to me that the origin of the regularity of both the magic figures and this phenomenon in acoustics, is due to an analogous law of symmetry.

The dominance of one order *o*, *ro*, *i*, or *ri*, in each cell of an even magic square, is simply due to a definite method of their selection from the four different orders of counting. Never can a figure appear in a cell where it does not belong by right of some regular order, either *o*, *ro*, *i*, or *ri*.

1	35	4	33	32	6
12	8	28	27	11	25
24	17	15	16	20	19
13	23	21	22	14	18
30	26	9	10	29	7
31	2	34	3	5	36

1	5	33	34	32	6
30	8	28	9	11	25
18	23	15	16	20	19
24	14	21	22	17	13
7	26	10	27	29	12
31	35	4	3	2	36

6 × 6 EVEN SQUARES.

The magic square of 4×4 , consists only of *o* and *ro* figures, and the same rule applies to the simplest construction of even squares of multiples of four, such as 8×8 , and 12×12 .

There are several ways of constructing a magic square of 6×6 . Our first sample consists of 12 *o*, 12 *ro*, 6 *ri*, and 6 *i* figures. The 12 *o* hold the diagonal lines. The 12 *ro* go parallel with one of



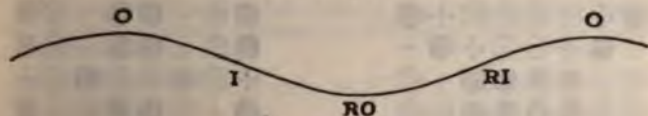
CHLADNI FIGURES.*

* The letter *a* indicates where the surface is touched with a finger; while *b* marks the place where the bow strikes the glass plate. In the four upper

these diagonals, and stand in such positions that if the whole magic square were diagonally turned upon itself, they would exactly cover the 6 *i*, and 6 *ri* figures. And again the 6 *i* and 6 *ri* also hold toward each other places in the same way corresponding to one another; if the magic square were turned upon itself around the other diagonal, each *ri* figure would cover one of the *i* order.

If we compare the magic squares with the sand-covered glass plates which Chladni used and think of every cell as equally filled with the four figures that would fall upon it according to the normal sequence of *o*, *ro*, *i*, and *ri*; and further if we compare their change into a magic square to a musical note harmonizing whole rows into equal sums, we would find (if by some magic process the different values of the several figures would mechanically be turned up so as to be evenly balanced in rows) that they would present geometrically harmonious designs as much as the Chladni acoustic figures.

The progressive transformations of *o*, *ro*, *i*, and *ri*, by mirroring, are not unlike the air waves of notes in which *o* represents the crest of the wave, *ro* the trough, *i* and *ri* the nodes.



In placing the mirror at right angles progressively from *o* to *i*, from *i* to *ro*, from *ro* to *ri*, and from *ri* to *o*, we return to the beginning thus completing a whole sweep of the circle.* The reverse of *o* which is *ro* represents one-half turn, *i* and *ri* the first and third quarter in the whole circuit, and it is natural, therefore, that a symmetry-producing wave should produce a similar effect in the magic square to that of a note upon the sand of a Chladni glass plate.

MAGIC SQUARES IN SYMBOLS.

The diagrams which are offered here, as samples, are the best evidence of their resemblance to the Chladni figures, both exhibiting in their formation, the effect of the law of symmetry. The most elegant way of rendering the different orders, *i*, *ri*, *o*, and *ro*, visible at a glance, would be by printing the cells in four different colors,

diagrams the plate has been fastened in the center, while in the lower ones it has been held tight in an excentric position, indicated by the white dot.

* See diagram on page 125.

but for proving our case, it will be sufficient to have the four orders represented by four symbols, omitting their figure values, and here propose to indicate the order of *o* by ●, *ro* by ⊗, *i* by ○, and *ri* by +.



8 × 8. 32 *o* and 32 *ro*.



10 × 10. 72 *o* and 72 *ro*.

SQUARES OF MULTIPLES OF FOUR.

Constructed only of *o* and *ro*.



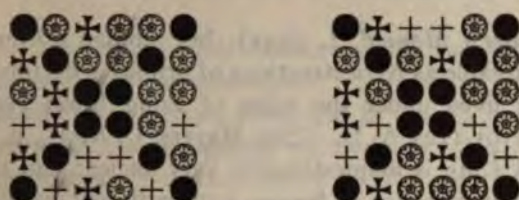
8 × 8 SQUARES.

Constructed from all the orders, *o*, *ro*, *i*, and *ri*.



ANOTHER 8 × 8 SQUARE.

It will be noted that in this square the arrangement of the *o* symbols corresponds very closely to the distribution of the sand in the second of the Chladni diagrams. The same may be said of the two following figures, and it is especially true of the first one of the 8 × 8 squares just preceding.



12 o, 12 ro, 6 i, 6 ri.



40 o, 40 ro, 10 i, 10 ri.

The reader will notice that there is a remarkable resemblance between the symmetry displayed in this figure and in the fourth of the Chladni diagrams.

EXAMPLES OF 6×6 AND 10×10 MAGIC SQUARES.

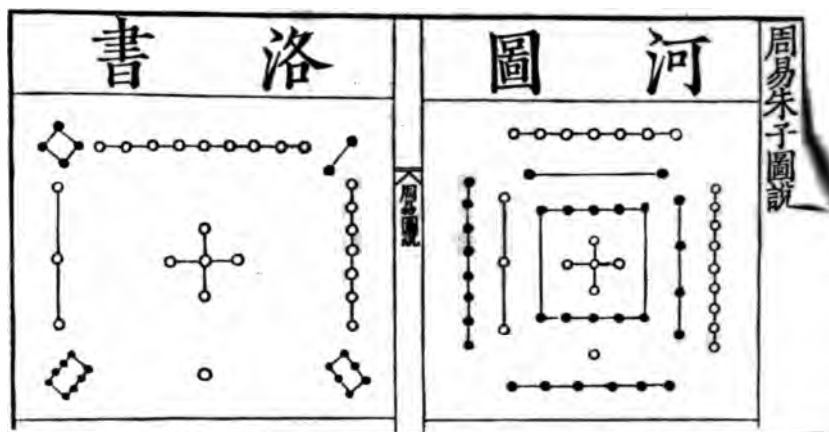
THE MAGIC SQUARE IN CHINA.

In the introduction to the Chou edition of the *Yih King*, we find some arithmetical diagrams and among them the *Loh-Shu*, the scroll of the river Loh, which is a mathematical square from 1 to 9, so written that all the odd numbers are expressed by white dots, i. e., yang symbols, the emblem of heaven, while the even numbers are in black dots, i. e., yin symbols, the emblem of earth. The invention of the scroll is attributed to Fuh-Hi, the mythical founder of Chinese civilization, who according to Chinese reports lived 2858-2738 B. C. But it goes without saying that we have to deal here with a reconstruction of an ancient document, and not with the document itself.

The first unequivocal appearance of the *Loh-Shu* in the form of a magic square is in the latter part of the posterior Chou dynasty (951-1126 A. D.) or the beginning of the Southern Sung dynasty (1127-1333 A. D.). The *Loh-Shu* is incorporated in the writings of Ts'ai Yüan-Ting who lived from 1135-1198 A. D. (cf. Mayers,

Chinese Reader's Manual, I, 754a), but similar arithmetical diagrams are traceable as reconstructions of primitive documents among scholars that lived under the reign of Sung Hwei-Tsung, which lasted from 1101-1125 A. D. (See Mayers, *C. R. M.*, p. 57.)

The *Yih King* is unquestionably very ancient and the symbols yang and yin as emblems of heaven and earth are inseparable from its contents. They existed at the time of Confucius (551-479 B. C.), for he wrote several chapters which are called appendices to the



THE SCROLL OF LOH.

THE MAP OF HO.*

(According to Ts'ai Yüang-ting.)

TWO ARITHMETICAL DESIGNS OF ANCIENT CHINA.

Yih King, and in them he says (III, I, IX, 49-50. *S. B. E.*, XV, p. 365.):

"To heaven belongs 1; to earth, 2; to heaven, 3; to earth, 4; to heaven, 5; to earth, 6; to heaven, 7; to earth, 8; to heaven, 9; to earth, 10.

"The numbers belonging to heaven are five, and those belonging to earth are five. The numbers of these two series correspond to each other, and each one has another that may be considered its mate. The heavenly numbers amount to 25, and the earthly to 30. The numbers of heaven and earth together amount to 55. It is:

*The map of Ho properly does not belong here, but we let it stand because it helps to illustrate the spirit of the times when the scroll of Loh was composed in China. The map of Ho contains five groups of odd and even figures, the numbers of heaven and earth respectively. If the former are regarded as positive and the latter as negative, the difference of each group will uniformly yield +5 or -5.

by these that the changes and transformations are effected, and the spiritlike agencies kept in movement."

This passage was written about 500 B. C. and is approximately simultaneous with the philosophy of Pythagoras in the Occident, who declares number to be the essence of all things.

One thing is sure, that the magic square among the Chinese cannot have been derived from Europe. It is highly probable, however, that both countries received suggestions and a general impulse from India and perhaps ultimately from Babylonia. But the development of the yang and yin symbols in their numerical and occult significance can be traced back in China to a hoary antiquity so as to render it typically Chinese, and thus it seems strange that the same idea of the odd numbers as belonging to heaven and the even ones to earth appears in ancient Greece.

I owe the following communication to a personal letter from Professor David Eugene Smith of the Teachers' College of New York:

"There is a Latin aphorism, probably as old as Pythagoras, *Deus imparibus numeris gaudet*. Virgil paraphrases this as follows: *Numero deus impare gaudet*. (Ecl. viii, 75). In the edition I have at hand* there is a footnote which gives the ancient idea of the nature of odd and even numbers, saying:

"...*impar numerus immortalis, quia dividi integer non potest, par numerus mortalis, quia dividi potest; licet Varro dicat Pythagoreos putare imparem numerum habere finem, parem esse infinitum* [a curious idea which I have not seen elsewhere]; *ideo medendi causa multarumque rerum impares numeros servari: nam, ut supra dictum est, superi dii impari, inferi pari gaudent*.

"There are several references among the later commentators to the fact that the odd numbers are masculine, divine, heavenly, while the even one were feminine, mortal, earthly, but I cannot just at this writing place my hands upon them.

"As to the magic square, Professor Fujisawa, at the International Congress of Mathematicians at Paris in 1900, made the assertion that the mathematics derived at an early time from the Chinese (independent of their own native mathematics which was of a somewhat more scientific character), included the study of

*P. Virgilii Maronis | Opera, | cum integris commentariis | Servii, Philargyrii, Pierii, | Accedunt | Scaligeri et Lindenbrogii | | Pancratius Masvicius | . . . | Tom. I, | . . . | Leonardiae, | . . . | . . . c1510ccxvii.]

a distribution of the figure values in what might be called absolute equilibrium.

First we must observe that the Jaina square is continuous, by which I mean that it may vertically as well as horizontally be turned upon itself and the rule still holds good that wherever we may start four consecutive numbers in whatever direction, backward or forward, upward or downward, in horizontal, vertical, or slanting lines, always yield the same sum, viz. 34, which is $2(n^2+1)$; and so does any small square of 2×2 cells. Since we can not bend the square upon itself at once in two directions, we make the result visible in the adjoined diagram, by extending the square in each direction by half its own size.

10	5	16	3	10	5	16	3
15	4	9	6	15	4	9	6
1	14	7	12	1	14	7	12
8	11	2	13	8	11	2	13
10	5	16	3	10	5	16	3
15	4	9	6	15	4	9	6
1	14	7	12	1	14	7	12
8	11	2	13	8	11	2	13

THE SQUARE EXTENDED.

Wherever 4×4 cells are taken out from this extended square, we shall find them satisfying all the conditions of this peculiar kind of magic squares.

The construction of this ancient Jaina equilibrium-square requires another method than we have suggested for Mr. Andrews' "perfect squares," and the following considerations will afford us the key:

First we write the numbers down into the cells of the square in their consecutive order and call the four rows in one direction A, B, C, D; in the other direction 1, 2, 3, 4. Our aim is to re-distribute them so as to have no two numbers of the same denomination in the same row. In other words, each row must contain one and only one of each of the four letters, and also one and only one of each of the four figures.

these squares, however, give known."

As to our letter:

"The number in the eleventh and twelfth centuries. Mathematicians had found in the circles a peculiar property. Here,

an individual must perhaps or later scientific

It seems that in the century recapitulation can be

Practical according to all figures sum of that in



B, C, D, and the figures, 1, 2, 3, 4, are harmoniously distributed over the whole square, so as to leave to each small square its distinct individuality, as appears from the following diagram:

A	B	C	D
D	C	B	A
B	A	D	C
C	D	A	B

1	4	2	3
2	3	1	4
3	2	4	1
4	1	3	2

THE ARRANGEMENT OF LETTERS AND FIGURES.

The center square in each case exhibits a cross relation, thus:

C	B
A	D

3	1
2	4

In a similar way each one of the four groups of four cells in each of the corners possesses an arrangement of its own which is symmetrically different from the others.

* * *

I have had some correspondence on the Jaina square with Mr. W. S. Andrews, and after a perusal of my article he sends me the following suggestions:

"There are some secondary features connected with magic squares apart from their chief characteristic that every main column sums up to the same total amount. Two of these secondary features are as follows:

"First—That any two numbers which are equidistant from the center of the square shall amount to the sum of the first and last numbers of the series.

"Second—That every sub-diagonal column shall sum up to the same total amount as the main columns, thus making a square which is 'continuous' in any direction from any column.

"The ordinary magic square of 4×4 possesses the first characteristic but not the second. The Jaina square possesses the second characteristic but not the first. The 5×5 magic square given in Fig. 5 of my article possesses both characteristics."

... diagrams, adding there

		7	12	1
		2	13	8
		16	3	10
		9	6	15

1	0	5
2	1	3
3	2	0
4	3	6

— 3 —

10	18	1	14	22
11	24	7	20	3
17	5	13	21	9
23	6	19	2	15
4	12	25	8	16

§ 1. § MAGIC SQUARE.*

The sum of any two numbers that are n apart is $n + 1$.
The sum of the numbers in each column is equal to $n(n+1)/2$.
Andrews' article on "Magic Squares," in the Octob

This feature implies *continuity* in the derived magic squares.

In square IV,—*Both* of the above characteristics obtain.

Mr. Andrews adds that he has not succeeded in making any arrangement of letters and numbers in squares I, II, or III which will embody *both* of the above characteristics.

THE PHILOSOPHICAL SIGNIFICANCE OF NUMBER.

Although magic squares have no immediate practical use, they have always exercised a great influence upon thinking people. It seems to me that they contain a lesson of great value in being a palpable instance of the symmetry of mathematics, throwing thereby a clear light upon the order that pervades the universe wherever we turn, in the infinitesimally small interrelations of atoms as well as in the immeasurable domain of the starry heavens, an order which, although of a different kind and still more intricate, is also traceable in the development of organized life, and even in the complex domain of human action.

Magic squares are a visible instance of the intrinsic harmony of the laws of number, and we are thrilled with joy at beholding this evidence which reflects the glorious symmetry of the cosmic order.

Pythagoras says that number is the origin of all things, and certainly the law of number is the key that unlocks the secrets of the universe. But the law of number possesses an immanent order, which is at first sight mystifying, but on a more intimate acquaintance we easily understand it to be intrinsically necessary; and this law of number explains the wondrous consistency of the laws of nature. Magic squares are conspicuous instances of the intrinsic harmony of number illustrating the harmony of the spheres, and so they will serve as an interpreter of the cosmic order that dominates all existence.

Magic squares are a mere intellectual play that illustrates the nature of mathematics, and, incidentally, the nature of existence dominated by mathematical regularity. They illustrate the intrinsic harmony of mathematics as well as the intrinsic harmony of the laws of the cosmos.

The wisdom which we can trace in the cosmic order is not artificial, not the product of premeditated thought, not the result of an excogitated plan, but innate in existence itself. It is necessary

It is not originated by the fiat of a God. It is being itself eternal and omniscient, invulnerable, and unqualified, which means its efficiency without conditions. It is not the effect of a cause, but is the cause of all causation.

It is not a "cause of itself" (that is, cause of itself), but we must not say it is self-contradictory. There is no effect that would be its own cause, and there is no first cause. Cause and effect are relative terms, and every cause is the effect of a prior cause. Every act or motion or disturbance of any kind, every change in the system of conditions, calls forth further change, a rearrangement of the conditions, which is what Spinoza means to say is that God or the *Deus sive Natura* is the universal *raison d'être* of all things, the principle of explanation, and the supreme power.

We must not distinguish between two important ideas, cause and effect, and instead of speaking, as he intends to do, of the first cause, thus leading down to the present day has proved a stumbling block to innumerable philosophers who succeeded him. Reason, unlike cause, does not answer to the question why. Reason, unlike cause, which always is event in the objective world, formulates a law that explains some event or class of events. Hence reason in the objective world means only our argument; and in the objective world the general law which dominates the course of events to be explained. It is intended to explain the isolated events of a system, or a great system, and so comprehension comes only in systematizing knowledge, and the different reasons are subsumed under general laws, and can be represented by one universal *raison d'être*.

When considered by themselves, constructed independently of each other, have been worked out in the sciences of pure mathematics with all its branches, arithmetic, algebra, geometry, and what Kant calls pure nature-science) which express a critical and scientific view of causality, of the law of matter and energy, and kindred ideas. It is the reason that these so-called absolute branches

of knowledge play such an important part in the comprehension of the world?

The purely formal sciences possess the strange quality of being constructed by the human mind without utilizing external experiences; they are what Kant calls "*a priori*," that is, they antedate experience; their validity is not based upon experience, but conditions it; they hold good before we begin to make experiences, and experience presupposes their validity. If they were not valid, experience would be impossible. While thus the formal sciences seem to be mind-made, they are after all the basic laws of objective existence, and the agreement between the basic laws of the mind and the highest laws of objective existence, does not teach us, as Kant says, that the order of the world is purely subjective, and transferred from the thinking mind upon the surrounding cosmos, from our own mental or ideal inside into the actual and real outside of space, from the subject to the object—a system which he calls "critical idealism"; it teaches us the intrinsic necessity of the universal laws governing any possible kind of existence; and we learn thereby that their basic principle may be condensed in the one word—consistency. It means that whatever originates, exists, or is created, (if there is any consistency at all) will according to conditions produce a definite kind of an order.

In arithmetic we create a universe of figures by the process of counting; in geometry we create another universe by drawing lines in the abstract field of imagination, laying down definite directions; in algebra we produce magnitudes of a still more abstract nature expressed by letters; and if we think of the material world as being created by a God, it must have been brought about by producing bodily forms. In all these cases the first step producing the general conditions in which we move, lays down the rule to which all further steps are subject, and so every one of these universes is dominated by a consistency, producing a wonderful symmetry, which in the cosmic world has been called by Pythagoras "the harmony of the spheres."

The intrinsic necessity of symmetry explains better than Kant's idealism why the mind-made laws of mathematics agree so closely with the laws of nature governing the material universe; both are applications of the same order underlying every consistent system, and we know very well that the mathematician creates, not in subjective arbitrariness, but after the intrinsic necessity of the first start from his position; and the objective realities, the laws of nature, which correspond to his theorems, are not nonentities, not

abstractions without meaning, but they are the dominating factors that shape all things in particular and the world in general. The system of these factors has not been made by the creator to suit his plans of creation, but it is the worthiest part of the creator himself. Humanly speaking we may call it the eternal constitution of the creator's mind. It alone marks the divinity of God, whatever we may understand by that name, and it alone is the Godhead of God.

THE GOD PROBLEM.

I have discussed the God problem before, but the subject is of such great importance and far-reaching consequence, that I will discuss it again in this connection, even at the danger of repeating myself.

There are two hostile parties in religion confronting each other. The one explains the mystery of the world order by the assumption of a personal God, an omnipotent, divine personality, in whose image man has been created; a being, who, like man, is possessed of will, intelligence and sentiment, who thinks and acts and plans as we do; the other party reduces everything to chance with its infinite possibilities. The two theories exclude one another, so that if one be true the other is necessarily wrong. Advocates of the former believe that God fashioned the world order to suit his purpose; those of the latter look upon the universe as a soulless, mindless, meaningless congeries of matter, exhibiting in its whirl of commotion many accidental uniformities. It is frequently assumed that no third proposition is possible, since these two appear to be contradictory. Because the iconoclastic proposition is very unsatisfactory, theists argue that we should accept belief in a personal God, on the ground that it is after all the most comforting and satisfactory solution. We, however, deem both positions to be faulty, and their contradictory feature is due solely to a slight misunderstanding of the true nature of the constitution of the world, as well as the significance of the God idea. Thus we take a middle ground which concedes to both parties some of their most vital contentions, and at the same time criticizes both for misstatements, which necessarily obscure the whole issue.

On the one side, we grant to the atheist that the world order can not have been fashioned by a God, for it is itself immutable and eternal; but at the same time we criticise in the atheist's posi-

tion his lack of appreciation of the world order as both the creative factor and the standard of moral conduct and truth; or, to speak religiously, as the divinity immanent in nature. We agree with the materialist that all concrete existence is material, we criticise him when he claims that there is no reality except that of matter. The interrelation of things, the formal aspect of being, and with them the laws of pure form, are not nonentities but the most essential features of reality. Neither matter nor energy is the most important part of the world. That which makes things such as they are is their form; and though the laws of form seem to be pure nothingness because they are not material entities, they are nevertheless the quintessence of being, for they alone, and not material things, condition the differences that constitute better and worse, higher and lower, valuable and worthless, good and evil, right and wrong, truth and falsehood. Stones and all other bodily objects are real; but the laws of nature, though not material, are after all actual presences in the world. They are more than real, they are super-real. Without them life would possess no significance and so we see that the materialist is onesided in his pretensions.

In extenuation of the errors of materialism we must remember that it was invented to deny the ghost existence of spirit. Spirit should not be regarded as a thing-in-itself. But neither should matter,—and as for that, spiritual life is as real as form, and the laws of form to which it owes its existence.

The theist appreciates the dignity of the cosmic order as a moral factor in the world, and is even right in representing it as the creator, the ruler, the supreme judge; but he is wrong in attributing to God human form, and the human constitution of individual existence. A personal God, (i. e., the deity conceived as an individual being) is a mere allegory, and the theist falls a prey to the pagan tendency of primitive man when he takes religious allegories in a literal sense and insists on the very points where the allegory fails.

While the method of representing God as a person is justifiable as an allegory, because the symbol itself is dignified and appropriate (man's personality is after all the highest type among all the creatures in the whole realm of creation), we must not forget that the very attributes of divinity exclude some of those features which are essential in the personality of man. The attributes of God are eternality, omnipresence, universality, omniscience, unqualified justice, spirituality, etc. Eternality excludes at once the assumption of God's thought being successive like the thinking of man. In

Isaiah (lv. 9) God says,—“As the heavens are higher than the earth, so are . . . my thoughts than your thoughts,” and we insist that the difference between God’s thought and man’s is not even a mere difference of degree. While man’s thoughts are temporal, being successive in time, God’s are above time: they are simultaneous and omnipresent like the laws of nature. They are not dependent on time and space, but are operative in potent and immediate efficacy. Man’s consciousness is the product of mental activity; it originates from feeling, and is practically nothing but an intensified state of sentiency. It is needed as a guide for man’s life, so as to make it possible for him to adapt himself to circumstances. God is not in need of any adaptation to circumstances. He is not possessed of a consciousness like that of man, and the consistent conception of omniscience excludes the mechanism of consciousness which admits the several ideas, or objects of thought only successively within the limits of special attention. Omniscience means that all the divine thought is at once present in God. As eternality means that they are above time, so omniscience means that they are above space. They are not concentrated on a special spot after the fashion of cerebral activities in man, but they are independent of any mechanism. The materialist would say that because they are not material things such as stones or our own bodies, that they are non-existent; but we claim that for all that they are efficient; and if they are not real in the narrow sense of the word, if they are not concrete objects, they are nevertheless efficient presences, and so we rightly call them super-real.

The same is true as to the other divine attributes. The inter-adjustment of the whole harmony that pervades the cosmic order is so perfectly balanced that no fault can be found with it, and where we would take exception to the evils of existence, we will always find out, if we only patiently investigate, that the basic principle is right and could not be changed. Justice in the constitution of the world is nothing but the recognition of right adjustment, and so whatever the ills of life may be, God will remain justified.

While the iconoclasts, atheists, materialists, and kindred thinkers, look upon the uniformities of nature as accidental, we regard them as intrinsically necessary. According to our experience we find nothing in life which is not dominated by uniformity, and all events that seem to be isolated, and would not admit of being classified in the system of uniformities built up by science, are simply evidences of our ignorance, and though there be many of

them, there is no scientist who would look upon them in a different light. The whole world with all its phases, is subject to this immutable order of natural laws, and the assumption of accidental origin is absolutely excluded. The world order is a reality, or rather a superreality. It is possessed of all the divine attributes, and being a systematic whole, it constitutes a specific organism of a definite character, comparable to a personality.

While the cosmic order is not like man, we recognize at once that man was created in its likeness; for man originated by a recognition of universals, by discovering the general in the particular. The precedence of man over the beast is his reason, and man's reason (the *logos* of Neo-Platonism) is nothing but the becoming conscious of the uniformities of nature and interpreting them as universals, as instances of a type, and by comprehending the laws in which single cases find their application.

This idea has been indicated in the Gospel where it is said that the *logos* (that is the logical world order) was with God in the beginning and that it was God himself. Man, however, has become man only by a participation in the *logos*. To the extent that the *logos* has become incarnate in man, man has realized his humanity, and the highest ideal of manhood is the God-man, the *logos* incarnate.

Though God is not personal in the sense of human personality, we must not say that he is *impersonal*, for that would appear as if divinity were less than man. The very opposite is the case. God being the prototype of man, man being formed in the likeness of God by incorporating in himself the divine *logos*, we must recognize that God, the prototype of all personality, is not less than a person, but more than a person, and noticing that the totality of divine thought which we trace in the laws of nature, constitutes a system not unlike the organism of a personal being, we prefer to characterize God as superpersonal. The negation of the human in God does not deprive him of anything divine, and the divine features which make man akin to God, are better, nobler and more divine than they are in any individual personality.

We do not limit God to the laws of nature, although we do not hesitate to characterize our God-conception as "Nomothetism." But by *nomos* we understand any norm, and God is the entirety of all that is eternally and universally normative. This eternal norm shows itself most palpably in the laws of reason and laws of nature, but we do not mean to limit our view of God to that feature of the

THINKING WHICH UNDER THE PRESENT DISPOSITIONS ARE MATERIAL LAWS, the capacity is capacity therefore. The aspect of God which furnishes it is not a part of his being, and important though it may be, it is not the most important one. There are other aspects within the reach of our knowledge, and other additional possible ones. There is the aspect which the mystic takes in his secret attitude of rapture being; there is the aspect of adoration in the worshiper; there is the aspect of aspiration to an ideal that grows in the soul of the moralist; and none of them is sufficient to exhaust the significance of the divine presence in which we live and move and have our being. No limit can be found with an attempt of the human mind to reach out in appreciation of the divine spirit, nor in any reaching for a closer and more intimate union with him, if only those who accept these several aspects recognize themselves as their insufficiency, and would not, as does the fragment, take allegories literally and look upon their own individual and particular standpoint as the only possible and only allowable one.

I am far from saying that all aspects are of equal value: on the contrary, we can easily discriminate between the lower and the higher, between the more or less true, between the more or less rational, more or less free from superstition, more or less purified, more or less exalting. I insist only on the insufficiency of any one of them which leaves out a recognition of the others.

God, although not a material being, although nowhere in space, and never in time, nowhere here or there, and never now and then, is not a nonentity. Though he is not a force, nor an energy, nor even the sum total of energy in the world, he is not inefficient. On the contrary he is omnipotent. His power is not to be measured in foot-pounds, yet his will, if we may use this humanizing term allegorically, is irresistible. He is an all-efficient presence in all happenings, and there is nothing that does not subsist through him.

Nomothicism is not pantheistic. Pantheism identifies God and the universe, and according to nomothicism, God is different from the concrete and material universe. God is in the universe, and it so happens that the old paradox is justified, that the part is greater than the whole. But God is not only present in the universe, he is present even in non-existence; that is to say the purely formal laws of being hold good not only for the actualized world, but for any possible world, for all the future, for all the past, for all the sys-

tems of thought constructed by science, and even for those universes that will never be created. The eternal norm of the divine principle is actualized in nature, but it is above nature, because nature is, as it were, only a single instance of the infinite possibilities to which it applies or could apply. Thus God is not limited to the cosmic order of nature, but is supernatural in the literal sense of the word. No system of things or beings, either real or imaginary, could exist without him, except perhaps a chaos; yet even that would be so filled with self-contradictory inconsistencies or irrational unthinkables that (if it be a true chaos) it would be thinkable only as a vague idea; it could not stand, for it would be doomed to die even before an attempt were made to call it into existence.

There is no prophet that preaches the superpersonal God more plainly than mathematics, and the magic squares are like a magic mirror which reflects a ray of the symmetry of the divine norm immanent in all things, in the immeasurable immensity of the cosmos not less than in the mysterious depths of the human mind.

EDITOR.

MR. PETERSON'S PROPOSED DISCUSSION.

Very valuable ideas oftentimes appear so obvious, when once set forth, that high laudation of their inventors would invite ridicule. Such, we are told, was the notion that obsessed C. Colombo, and such is Mr. Peterson's proposal to start in *The Monist* a discussion of philosophical terminology. It may be a very simple proposal, but nobody, as far as one careful reader of *The Monist* remembers, had made it before; and its utility to students of phenomenology, normative science, and metaphysics will have a high co-efficient in its proportionality to the advantage they take of it. Duty calls upon us to contribute, each one what he can that will be useful, whether in the way of question or in that of answer. It seems likely that in my life-time of study I may have learned something of the way to investigate questions such as Mr. Peterson puts; and if so, here is an opportunity to be of aid to other students.

Experience, the first term concerning which Mr. Peterson asks for light, is somewhat remarkable for having been employed as nearly as possible in the same sense from Polus the Acragentine (i. e. native of Girgenti) sophist down to Avenarius and Haeckel.

As my first step in investigating its meaning, I should look out its equivalent *empeiria*,¹ in Bonitz's *Index Aristotelicus*. For every serious student of philosophy ought to be able to read the common dialect of Greek at sight, and needs on his shelves the Berlin Aristotle, in the fifth volume of which is that index. On looking out *empeiria* there, what first strikes one is that it is not a very common word with Aristotle, nor yet an unusual one, since Bonitz cites something over a dozen passages in which it occurs. The first (*Post. Anal.* II, xix), runs: "From sense are engendered memories, and from multiplied memory of the same thing is engendered experience; for many memories make up a single experience." Waitz (*Organon*, II, 429,) has a minute note on this passage. Another passage to which the Index refers (*Nic. Ethics*, VI, viii,) is thus translated by Stewart in his valuable "Notes" on the work: "If we ask why a boy may be a mathematician, but cannot understand philosophy or natural science, we find that it is because the truths of mathematics are abstract" [a bad explanation but that does not affect the evidence as to the meaning of *empeiria*,] "whereas the principles of philosophy and natural science are reached through long experience. A boy does not realize the meaning of the principles of philosophy and natural science, but merely repeats by rote the formulae used to express them." In the *Politics* (A, xi) Aristotle remarks that theorizing is free, while experience is necessitated, and goes on to speak of experience with live stock, etc. In another place in the *Politics* (E, ix) he says that the military commander of greatest experience in strategy is to be preferred, even though his habit of peculation be known; while for the chief of police, or for a treasurer, experience is of no account in comparison with integrity. But the cynosural passage is the first chapter of Book A of the *Metaphysics*; and here he remarks (as he likewise does in the *Ethics*,) that experience is a knowledge (*gnosis*)² of singulars. Therein Aristotle's language differs from that of the Socrates of Plato, with whom *empeiria* is the skill that results from long dealings with any matter. Aristotle never intended to say that there is no other cognition of singulars than in experience; for that would directly contradict his doctrine that experience is a mass of memories relating to the same subject. His remark was, however, understood in the Middle Ages to be a definition of experience, and was repeated as such, a blunder that was not so unnatural as it would have been if the scholastic doctors had dealt

¹ *ἐμπειρία*.² *γνῶσις*.

with direct experience. The teachings of the *Aristotelic Index* having been exhausted, I turn to Harper's *Latin Lexicon*, which informs me that no writer of the Golden Age used *experientia* in the general sense, though that acception became common in the Silver Age, especially with Tacitus. The next work that I personally should consult would be my own notes collected during more than forty years. I always carry a pad of the size of a Post Card, of thick papers, (50 in a pad, enough to last for two days, at least); and on these I note whatever elements of experience may reach me. I keep these in drawers and boxes like the card catalogue of a library. I arrange and rearrange them from time to time. It is a treasure more valuable than a policy of insurance. I probably have near two hundred thousand such notes. But in order to bring what I have to say to a close, I will quote from the definition of experience given by the father of modern experiential philosophy, Dr. John Locke. In the *Essay concerning Humane³ Understanding*, (II, i, 2) we read (and the italics are in the original): "Whence has [the mind] all the materials of reason and knowledge? To this I answer, in one word, from *experience*: in that our knowledge is founded, and from that it ultimately derives itself. Our observation employed either about *external sensible objects*, or about the *internal operations of our minds*, perceived and reflected on by ourselves, is that which supplies our understanding with materials of thinking." This definition so formally stated, by such an authority, quite peerless for our present purpose, should be accepted as definite and as a landmark that it would be a crime to displace or disturb. For in order that philosophy should become a successful science, it must, like biology, have its own vocabulary; and as in biology, it must be the rule that whoever wishes to introduce a new concept is to invent a new word to express it. This is no suggestion of the moment. I am, for my humble part, maturely convinced that philosophy will never be upon the road to sound results until we dismiss our affection for old words and our dislike of newfangled words, and make its vocabulary over after the fashion of taxonomic zoölogy and botany. I limit my recommendation to technical terms; for I can pretend to no competence to give advice about *belles-lettres*. Yet even there I perceive that people read old authors, and admire them for saying what they never meant to say; because the modern readers forget that two or three centuries ago words still familiar

³ *Humane* and *human* were one and the same word in Locke's day.

suggested quite different ideas from those the same words now suggest.

But somebody may object that Locke's definition is vague, being founded on a misconception of the nature of perception. Suppose, the objector will say, that a newborn male infant were to be brought up among a colony of men on a desert island, without ever having seen a woman and barely having heard of such a creature. Suppose that, arrived at the age of twenty, he were to meet on the beach a Pacific Island woman who had swum over from another island. Would not the irresistible, the only possible cognition he could have of this creature be strongly colored by his own instincts? It would be the ineluctable result of "*observation employed concerning an external sensible object.*" The word "experience," however, is employed by Locke chiefly to enable him to say that human cognitions are inscribed by the individual's life-history upon a *tabula rasa*, and are not, like those of the lower animals, gifts of inborn instinct. His definition is vague for the reason that he never realized how important the innate element of our directest perceptions really is.

To such an objector I might say, My dear fellow, you must be joking; for under the guise of an objection you reinforce what I was saying with a new argument for restricting the use of the word "experience" to the expression of that vague idea which Locke so well defines. You make it plain that a distinct word is wanted, or rather two distinct words, to express the two more precise concepts which you suggest. The idea of the word "experience," was to refer to that which is forced upon a man's recognition, will-he nill-he, and shapes his thoughts to something quite different from what they naturally would have been. But the philosophers of experience, like many of other schools, forget to how great a degree it is true that the universe is all of a piece, and that we are all of us natural products, naturally partaking of the characteristics that are found everywhere through nature. It is in some measure nonsensical to talk of a man's nature as opposed to what his perceptions force him to think. True, man continually finds himself resisted, both in his active desires and in that passive inertia of thought which causes any new phenomenon to give him a shock of surprise. You may think of an element of knowledge which thus resists his superficial tendencies; but to express precisely that idea you must have a new word: it will not answer the purpose to call it *experience*. You may also reflect that every man's environment

is in some measure unfavorable to his development; and so far as this affects his cognitive development, you have there an element that is opposed to the man's nature. But surely the word *experience* would be ill-chosen to express that.

But I am encroaching far too much upon the space of this number, and am taking too much advantage of our good editor's indulgence. I did wish to consider what element of his philosophy Comte had specially in mind in christening it *Positive*. He plainly meant that it should be unlike the metaphysical thought which kneads over and over what we know already, and would be like the sort of material which is furnished by a microscope or by an archæologist's spade. I hope Mr. Peterson's suggestion may bring a whole crop of fruit.

CHARLES SANTIAGO SANDERS PEIRCE.

MILFORD, PA.

BOOK REVIEWS AND NOTES.

WIE ICH WURDE WAS ICH WARD. Von *Julius Bahnsen*. Munich and Leipzig: Müller. 1905. Pp. lxxvii, 270.

Rudolf Louis, a friend and admirer of Julius Bahnsen, has edited an autobiography of this singular man, and accompanies it with an introduction in which are given the necessary data for an explanation of the author's significance. The book, however, is important mainly as a character study of a martyr of Prussian bureaucracy.

The editor, Rudolf Louis, calls Julius Bahnsen a philosopher, and we are far from grudging him this honor, if it may be considered as such, but the title is misleading, for the reader would expect a man of the type of Kant, Hegel or Spencer, or some one who has contributed toward the solution of philosophical or metaphysical problems. Bahnsen has done nothing of the kind. His contributions to philosophy are absolutely nil, but he is a philosopher in a broader sense. He is a thinker, a man of a contemplative disposition, who has pondered on his fate as well as his aspirations and surroundings. He was burning with ambition to do something for mankind, to be helpful to his fellow beings, especially his compatriots, and to have his ideals realized, but he has signally failed in this. Hence his life became a monotonous tragedy of a man forgotten, misjudged and ignored.

Rudolf Louis would lay the blame on the university professors who have silenced him, and thus cut off the arteries of his mental life; but the truth is that the university professors are quite innocent of his ill star, yet while it appears that the main fault was inherent in the character of the man himself, we would not say that the Prussian bureaucracy is free from blame. On the contrary, they should have been kinder toward him, and not have allowed an ingenious and aspiring man to wither in loneliness in a small town where he was deprived of the quickening spirit of sympathetic and congenial surroundings that would have helped to mature and educate this noble pessimist. Julius Bahnsen was an unfortunate character and his unhappy fate was predetermined by his own idiosyncrasies.

He was born in 1830 in Tondern in Schleswig, as the son of the principal of a teachers' seminary. He received the usual education, and when his little nation rebelled against the Danish yoke, he joined the Schleswig-Holstein company as a volunteer in 1849, and took part in its disastrous campaign, which ended in a lost battle and a shameful surrender. The participants, although formerly encouraged by Germany, were now exiled in 1851, and Bahnsen went to Tübingen to continue his studies as a philologist. At Tübingen

he took his degree as Doctor of Philosophy, but he did not feel at home among the Swabians. Though as a non-Prussian and an exile of Schleswig, he had the sympathy of his South German brethren, he felt the difference between the North and South German types too much not to look upon the Swabians as odd and uncongenial. In 1853 he accepted a position as tutor in Eutin-Schwartau; in 1854 he traveled to London; in 1855 to 1857 he taught in the private school at Altona. His favorite wish of settling in Oldenburg was not fulfilled. He applied for a position in the Gymnasium, but by one vote failed to be elected, and in 1858 he accepted an appointment as teacher at the Gymnasium at Anclam, Pomerania. If he found the Swabians uncongenial, he was more disappointed still in the Pomeranians, and he disliked especially the Prussian discipline, and the robust crudity of his Pomeranian colleagues as well as pupils. Under these circumstances he developed an anti-Prussian spirit which sought the salvation of Germany in a united empire, in which, however, every particular tribe should develop its own character and should be allowed to be itself.

His antipathy became more and more bitter and he was not a character to conceal his views, and so it was natural that both his colleagues and superiors were not favorably impressed with the Schleswig exile, and none of them tried to make him feel at home in his adopted country.

We must mention that Bahnsen had previously visited Schopenhauer mainly because his interest had been aroused by an unfavorable criticism of Schopenhauer's philosophy. We learn little of his interview with the great pessimist, and it seems that Schopenhauer's theoretical philosophy left no impression on Bahnsen, but the pessimism of the Frankfort philosopher agreed but too well with the misanthropy of the Schleswig exile, and his vain attempts to educate his pupils up to his own ideals, made him feel fully convinced that Schopenhauer's ideas of the unchangeableness of character were correct. His only work so far as we know in a properly philosophical or metaphysical line is an attempt at reconciling Schopenhauer's theory of the will with Hegel's dialectics. Not being known in university circles, however, his labors in this line were ignored while the author in his isolated position was not even afforded the salutary effect of friction by criticism.

As an educator and an observer of his surroundings Bahnsen concentrated his mind on a study of character, and published a series of essays on the subject under the title "Contributions to Characterology," which attracted some attention. But while his ability as an observer and thinker was recognized by his superiors, especially the ministerial counsellor, Ludwig Wiese, his sympathies with Schopenhauer could only make an unfavorable impression and branded him as an impracticable educator. Had he not himself acknowledged the impossibility of changing the character of his pupils by education? The result was that the counsellor after nine months wrote him a courteous letter, the real meaning of which, however, was written between the lines, which Bahnsen to his own disaster failed to understand. The counsellor expressed his view that he would find another sphere of life that would be more suitable for his talents. Bahnsen adds that it was in the power of the counsellor to afford him a more suitable occupation. He did not understand that a Prussian official was appointed to preserve the Prussian spirit of edu-

cation, and that the letter had gently hinted that Bahnsen might look for some position outside of Prussian educational institutions.

The opinion which the Prussian counsellor had formed of Bahnsen sealed his fate. It was transmitted to the authorities at Pomerania, and they executed the orders of the minister by transferring this dangerous man, who ventured to have views of his own in strict contradiction to Prussian notions, to a small town in a remote corner of farther Pomerania, where he received an appointment in a township gymnasium, depending entirely for his promotion on the will of a board of directors elected from the good citizens of the place. His promotion was not forthcoming, and his salary also remained small. An increase of salary had been promised him but it was not given, and when he appealed to the authorities they contended that they could not interfere with the local self-government of the place.

Bahnsen's lack of support on the part of the government was intentional. In fact we know from sources not contained in the book, and not known to Bahnsen and his friends, that they would have gladly discharged Bahnsen had they not preferred to avoid making a martyr of him, but to dwarf his spiritual growth and let his ambition die piecemeal of intellectual starvation. They have succeeded, and in reading over this unfortunate man's biography we ask the question whether he would have met with a better fate in life if he had left his uncongenial surroundings and sought another home in some other country. This is possible, but doubtful, for misanthropy was too integral a part of Bahnsen's character, and he was too proud to adapt himself to his surroundings.

As to his life at Lauenburg little remains to be said. He had married in 1863 Minnita Möller of Hamburg, but he lost her soon after the death of a baby girl in 1863. In Lauenburg he married the second time, Clara Hertzog, by whom he had four children, but this marriage was very unhappy and led finally to a divorce in 1874. No other reason was mentioned than incompatibility. In 1872 Bahnsen became acquainted with Hartmann, for whom he did some literary work, but while Bahnsen preserved his respect for Schopenhauer, he expressed a disdain for the philosopher of the unconscious, although in his enthusiasm he had called his third child Arthur Eduard Hartmann Bahnsen.

In Lauenburg he wrote different essays on "Will and Motive," 1870 (Stolp und Lauenburg i. P., H. Eschenhagen); "A Critical Discussion of the Hegel-Hartmann Evolutionism, Judged from the Standpoint of Schopenhauer," 1872, (Berlin: Carl Duncker); "A Contribution to the Philosophy of Language," 1877, (Leipsic: Wilhelm Wigand); "Mosaics and Silhouettes," 1877, (Leipsic: Otto Wigand); "The Tragic as the Law of the World and Humor as the Esthetic Form of Metaphysics," 1877, (Lauenburg, i. P.: F. Ferley); "Philosophy and Nationality," 1878, (Lauenburg i. P.: F. Ferley); "A Pessimist's Breviary, by an Initiate," 1879, (Berlin: Theobald Grieben) the first volume was published anonymously in 1879 and a second volume posthumously in 1882; "The Contradictions in Our Knowledge and in the Essence of the World," 1880, (Leipsic: Theobald Grieben); "Aphorisms of the Philosophy of Language, from the Standpoint of the Metaphysics of the Will," 1881, (Berlin: Theobald Grieben).

Bahnsen died on December 7, 1881, in his fifty-second year.

The title of the book is difficult to translate because the two words *wurde* and *ward* mean exactly the same thing, "became," and so are more than tautological, they are identical. It is characteristic of the odd idiosyncrasy of the man. The publishers have added Bahnsen's picture as a frontispiece, which helps to explain his unique personality.

THE MESSIANIC HOPE IN THE NEW TESTAMENT. By Shailer Mathews. Chicago: University Press. Price, \$2.50.

There is no doubt that Prof. Shailer Mathews of the University of Chicago is one of the ablest representatives of the school of higher Biblical criticism in this country. His recent work on *The Messianic Hope in the New Testament* is a valuable addition to theological literature along exegetical lines. The appearance of such thoughtful works as this written on a scientific historical basis by men of undoubted orthodoxy is the most hopeful indication of the time when the entire Christian Church will be purified of the primitive superstitious elements common to all nations in the childhood of their development, and will retain only such noble and inspiring truths as are in perfect accord with the broadening revelations of science; when it will recognize the kinship in thought of intelligent minds everywhere and of every affiliation. Special encouragement lies in the fact that this purification is coming from within the Church itself and that such scientific methods as this book represents not only are made use of by leaders of theological thought but are commended for practice to the many young students who in their turn are to influence the thought of a later generation.

The introductory chapter not only carries out its ostensible purpose of explaining the historical exegetical process which the author advocates for theological reconstruction, but also makes clear how far progressive Christian thinkers of to-day have advanced beyond a literal acceptance of the Scriptures. This deviation from the traditional interpretation is more general than we often realize. In speaking of the importance of separating the setting in which a thought is cast from its teaching, because people to-day do not think nor express themselves as they did in bygone centuries, Professor Mathews says: "How generally recognized this view has become in practical teaching may be seen in the abandonment of some of the most explicit directions of the New Testament on the ground that they were intended primarily and exclusively for Christians in some city like Corinth. Thus, for instance, few teachers would to-day assert that women should not speak in meetings, or that there was any divine regulation concerning the length of a Christian's hair. At the same time, these same teachers would assert that the general principles of orderly conduct and modest deportment which found expression in the apostle's directions to Græco-Roman Christians are as applicable to the Christians of to-day as to those of nineteen hundred years ago."

While thus repudiating the necessity of a word for word acceptance of the Bible, he believes the truth contained in it to be the object of revelation for he speaks of "criteria which shall enable one to distinguish the concepts and processes which conditioned the Biblical writers from the religious experience and truth which admittedly constitute the real substance of what we call revelation." These criteria are found in the popular concepts of Biblical times which, however, were not considered purely formal by those

who used them, but were doubtless intended to embody the truth as well to typify it.

Professor Mathews treats in detail of the historical method which is to be used to gain correct values in Biblical interpretation. The distinction to be kept in mind between the content of a teaching and the form in which it is cast, for men to-day cannot feel more than an "antiquarian interest" in anything but the content, and theologians of all men cannot afford to be anachronistic. The writer agrees with Professor Mathews that if his problem be carried out to its consistent end there is nothing to be more desired in the direction of a scientific valuation of the foundations of the Christian faith for "especially if the concept in question be one that obviously is derived from a cosmogony or a theology that does not square with historical and scientific facts and processes, it will not be difficult to give it its true value and significance for the constructive and systematizing processes." It is quite clear, however, that Professor Mathews applies this criterion carefully to all of the leading concepts involved in the tenets of Christianity; for instance, the immaculate conception, resurrection, and special revelation as a source of knowledge for matters pertaining to the religious life.

In regard to the concept of messianism the historical process would consist in discovering what the concept actually was by studying its history in Judaism and then whether or to what extent it exists in the New Testament in Jesus' own interpretation of his career, in its interpretation in the mind of the apostles and by the early Church. Messianism is the most obviously local and ethnic concept that influences the Gospel records, as it is the most frequent and consequently inevitable. Its importance for Christian theologians lies in the fact that it was "the medium through which his followers looked at Jesus, the form in which they expressed their appreciation of him and the warp of all their speculation as to his and their own future."

The introduction closes with an outline of the course the author is about to pursue in discovering the part this concept played in the doctrines of the early Church, and in how far it is formal and how far essential Christianity.

"We shall first of all attempt to discover and formulate the elements of eschatological messianism as it is found in the literature of Judaism; in the second place, we shall examine the New Testament to see how much or how little of this element is to be found on its pages; and, in the third place, we shall attempt to determine the influence of such an element in Christ thought, and as far as possible to discover what would be the result upon historical Christianity if it were removed or, more properly speaking, allowed for."

The result of his investigation concerning the early Church is that "formally, the Church was a group of messianists awaiting a kingdom that never came and indifferent to all customs of society except those that were essentially the Church was a group of men and women endeavoring to live the new religious and ethical life that had come to them from God through accepting Jesus as Christ express itself in social relations."

In general he concludes that there is an essential identity between the messianic hope of the two Testaments, the New modifying the Old when compelled to by actual facts in the life of Jesus. To allow for this concept of messianism, Professor Mathews believes, does not destroy the essentials

Gospel teaching, but makes them the more intelligible and convincing. These essentials he enumerates as the personality, the teaching and the resurrection of Jesus; a rational faith in God as Father; a certainty of divine forgiveness; an experience of the eternal life; an assurance of a complete life beyond and because of death. He says, referring to the ideal Christian, "To make these facts dynamic in reason and will, he may use whatever world-view he may regard as the modern equivalent of messianism, or whatever terms he may regard as supreme definition of that divine Personality whom the first Jewish believers called the Messiah."

L. G. R.

LA MORALE DANS LE DRAME, L'ÉPOPÉE ET LE ROMAN. Par Lucien Arréat. Paris: Alcan, 1906.

A third edition of M. Arréat's *Ethics in the Drama, the Epic and the Novel* has appeared at Alcan's. As it has been mentioned formerly in *The Monist* it will be sufficient now to recall its predominating thought which is the consideration of the dramatic actions imagined by poets as fictitious experiences which reproduce and interpret those of real life; and the use of the study of poetic creations as a means of criticising the moral systems which philosophers have built up as well as for the history of morality itself throughout the centuries and in social life.

Dramatic actions invented by poets are fictitious experiences, repeating and interpreting those of real life.

Systems of ethics are likewise interpretations. But the ideas which are matters for speculation to philosophical schools are lived out in novels and on the stage. The drama participates at the same time in both worldly and philosophical life. Therefore its creations seem specially adapted for illuminating the criticisms of systems established by philosophers, as well as to illustrate the formation and development of morality itself. Upon this idea is laid the foundation of M. Arréat's work.

In his preface he says: "If we were to investigate more closely the relation existing between the ethics of philosophers and of every-day life, between theoretical and practical ethics, we might say that the hero of a philosophy is an abstraction only to be found in books, and that the living individual of flesh and bone never personifies any doctrine, or if he does it is only incidentally. Neither the pure stoic, nor the pure Christian, nor the pure Kantian, nor the cold utilitarian actually exists. They are types which are either invented or proposed by our theories, but never figures taken from round about us. No ideal discipline takes hold of the whole man.

"Neither is the character in the drama this abstract hero, but he comes very near it, while the real living individual remains his model. The poet, however unconscious or indifferent he may be, carves his figures in a desired relief and chooses the circumstances which will allow him to design them with a precise outline. He borrows from history or legend such adventures as have moved the world or thrilled the imagination of men, or else he invents an action which he throws on the canvas of ordinary life. In any case he disposes facts with the purpose of throwing into relief a character which interests him, or a solution which satisfies his judgment. Belonging to his own time, the poet is imbued with the opinions that govern the age, and consequently gives a certain meaning to the theories he puts into prac-

tice. In creating he makes a moral experiment, and is permitted to conclude it as he chooses. It is enough that the action should be well managed, the experiment artistically worked out. The admiration of succeeding ages decides, and is given to work and literatures of widely differing genius."

SOCIOLOGICAL PAPERS. By *Francis Galton, E. Westermarck, P. Geddes, E. Durkheim, Harold H. Mann and V. V. Branford.* With an Introductory Address by *James Bryce.* Published for the Sociological Society. London: Macmillan & Co. 1905. Pp. xviii, 292.

This volume consists of the papers read before the Sociological Society in its first session in 1904, together with a report of some of the discussions which followed them. The president's opening address, by Mr. James Bryce, fitly serves for an introduction. The history and methodology of sociology are represented by the papers of Mr. Branford and Professor Durkheim on the relation of sociology to the social sciences and to philosophy. Pioneer researches in borderland problems are represented by Dr. Westermarck's paper on the position of woman in early civilization, and that of Mr. Mann on agricultural village life in England. Applied sociology is represented by the paper of Professor Geddes on "Civics," and that of Mr. Galton on "Eugenics," in which the first treats of cities and the other of their citizens. In the preface, responsibility for statement of facts and opinions advocated, is disclaimed for the society and laid entirely upon the individual writers and speakers.

The fifth and sixth volumes of the Harvard Oriental Series are devoted to the Brhad-devata, which is attributed to Saunaka, and comprises a summary of the deities and myths of the Rig-veda. It is translated into English and critically edited by Arthur Anthony MacDonell, Boden Professor of Sanskrit in the University of Oxford. (Price, \$1.50 per vol.)

The first volume contains the editor's introduction and the Sanskrit text together with seven indices of the Brhad-devata; while the second consists of the translation, each translated verse being immediately followed by its corresponding notes.

The Brhad-devata itself begins with a long introduction, consisting mainly of a classification and enumeration of the Vedic deities in connection with Prajapati and with the Vedic triad of Fire, Indra or Vayu, and Soma, as representing respectively the gods of the three worlds. This introduction closes with a grammatical discussion dealing with the different parts of speech, word-analysis, and a criticism of Yaska's errors in the division of words. Most of the work is concerned with stating the deities in right succession for the hymns and stanzas of the Rig-veda. It is however by no means merely an index of the deities, but contains also forty legends whose purpose is to explain the occasion of the composition of the hymns with which they are connected. This is the oldest systematic collection of legends which we possess in Sanskrit. They are told in epic style, and are connected historically with many of the Mahabharata stories. The text contains many other data connected with the deities, and a full discussion of the character of the Vaisvadeva hymns.

One of the most interesting and original investigations of the much-mooted subject of personal immortality is Prof. Gustav Theodor Fechner's little book, *On Life After Death*. The English translation by Hugo Wernekke, Head Master of the Realgymnasium at Weimar, first appeared in 1882, and was presented to its venerable author on his eightieth birthday. The book is written in a very popular style, and since the edition has long since been exhausted, the translator has thoroughly revised his work, which The Open Court Publishing Company now deems advisable to re-publish. A discussion of the publisher's position in regard to Professor Fechner's views, is contained elsewhere in this number of *The Monist*.

A CORRECTION.

To the Editor of The Monist:

In a discussion of the contemporary development of diplomacy in the July number of *The Monist* (Vol. XV, p. 474) the reviewer mentions as "the principle formulated by French kings in the impudent dictum, the ultimate reason of autocracy: *Car tel est notre bon plaisir*" and I regret to find here this trite assertion which is also a gross mistake.

Mr. Funck Brentano, who knows our seventeenth century so thoroughly, alluded to it quite recently in the review *Minerva* with reference to an historical novel by M. Henri De Régnier. "The *bon plaisir*," writes he, "is diplomatically a heresy, a barbarism, as Count Mas-Latria demonstrated in such a scholarly way in his conclusive article published by *La Bibliothèque des Chartes*. The only formula used in the royal acts is *tel est notre plaisir*, and these words are handed down by tradition from the very distant times when *plaisir* had a far more serious meaning. "At present," writes Froissart, "he (a count of Flanders) is pleased to obey the ordinances and pleasures of the king of France and the French."

The pleasure, or "good pleasure," if the latter be preferred, was the king's verdict pronounced by him as head of the State, after due deliberation with his council, and which could be delivered only after it was countersigned by a secretary of the government. Many facts also show that *bon plaisir* was not more exact in a figurative than in a literal sense.

I thought it of some use to send you this correction for the information of your readers. I have no doubt but you will be glad to be warned against ready made judgments, repeated by partially or ill-informed people.

PARIS, FRANCE.

LUCIEN ARRÉAT.

With the beginning of a new volume, we have decided to change the style of *The Monist* by having the more important essays printed in pica type, which we hope will make the reading of weighty matter easier; and we are especially glad to have secured for this first number of the new year, two articles on the physical constitution of the universe, a subject which is interesting to all speculative minds, and should therefore not be forgotten in philosophy. Both are popular in style so as to give a clear insight into the present status of our knowledge as to the elementary composition of the smallest units of the materials that constitute the universe.

Professor Lindemann's speech on "The Form of Atoms" is well supplemented by Mr. W. S. Andrews' "Manifestations of the Ether."

Professor Lindemann, who happens to be Rector Magnificus of the University of Munich, has kindly sent us the German original of the present essay which has served him as the official speech of his rectorate, and for interested readers we will state that it has just appeared in the *Süddeutsche Monatshefte* (Verlag von Adolf Bonz & Co., Stuttgart) from which it can be had in separate pamphlet form. Reference to others of Professor Lindemann's more technical expositions of the subject will be found in a footnote under the text.

The article by Mr. W. S. Andrews has been specially solicited to provide our readers with a popular sketch of the physical nature of the universe, giving particular consideration to the significance of Röntgen rays, radium, etc. And we have succeeded in procuring the man who in our opinion is best fitted for this purpose. Mr. Andrews has devoted his life to this specialty, and has been in personal contact with Mr. Thomas A. Edison, as an assistant in his inventive work.

He entered the service of Mr. Edison in 1879 when the great inventor was commencing the experimental development of his incandescent electric lamp and all the accessory apparatus required for a complete system of general distribution of electricity for lighting and other industrial purposes. Mr. Andrews was peculiarly fitted for this work by inclination and training, and in 1881 he was placed in charge of the testing of all the electric generators and other apparatus then being made under the Edison patents. In 1883 Mr. Edison entrusted to him the supervision of the electrical equipment of the Edison Electric Lighting Stations, and in 1885 he was appointed chief electrical engineer of the Edison Co. for isolated lighting. Since that date he has occupied many responsible and important positions, devoting his energies chiefly to engineering work in the field of electric lighting.

During the past eight or nine years Mr. Andrews has devoted much of his spare time to the study of X rays, radio-activity and other physical phenomena of this character, and being benefited by the suggestions and advice of one of the greatest inventors that has ever lived, and following the natural bent of his own gifted mind, he has established a reputation for himself as an authority in these lines of modern investigation and discovery

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evil is, but give me, O God, that sublime belief, that seeing evil I yet have faith."*

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THE MONIST

A QUARTERLY MAGAZINE

Devoted to the Philosophy of Science

Editor: DR. PAUL CARUS.

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 { MARY CARUS.

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CHICAGO

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1906

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THE MONIST

ON THE MONISM OF PROFESSOR MACH.¹

A CONSPICUOUS effort at realizing a monistic conception of life and the world has been put forward by a succession of thinkers, those who are interested in philosophical considerations as well as in natural science and nature-philosophy. The way in which the effort was made has differed greatly, however, in each case. We need think only of such names as Spinoza, Berkeley, Haeckel, and Ostwald. But perhaps even these have something in common with each other if we contrast their conceptions with Mach's scientific point of view.

Time and again, and even in his latest work,² Mach proclaims with especial emphasis his naturalistic standpoint in contrast to the philosophical. And it really seems to me as if in this circumstance lies one of the most noticeable differences between Mach's standpoint and that of any exponent of philosophy or natural philosophy, including also the Editor of this periodical.

Professor Mach congratulates the philosopher upon finding himself "in the fortunate position of possessing unshakable principles," while on his side he is satisfied as a naturalist "to consider even his surest and best-founded views and principles as provisional."

¹ Translated from Professor Kleinpeter's manuscript by Lydia Gillingham Robinson.

² *Erkenntnis und Irrtum, Skizzen zur Psychologie der Forschung*. Leipzig: Barth, 1905

Under these circumstances the question arises how it can be worth while for the scientist to content himself with so modest a rôle. Is he really at so great a disadvantage in comparison with the philosopher, and is it right that his speculations should rest on so weak a basis?

So many of the systems of world-conceptions with which naturalists have furnished the world seem to confirm this idea. But the well-informed man knows, too, how far removed from this are Mach's ideas and trend of thought. And if we glance over the greatest part of the work of this untiring investigator, it will not be hard to see wherein he discovers the critical point of the conceptions of natural science. Mach's glance is directed constantly not on the incomplete conclusions of natural science in regard to the entirety of the universe, but much more on the *modus operandi*, the method employed by the naturalist, which Mach has endeavored to lay bare by painstaking critical historical research, and which he constantly strives to promote and to free from all impediments, i. e., of a metaphysical nature. Thus his aim has always been to construct a monistic interpretation and at the same time to remove the barriers which separate one department from another. Especially has he endeavored to bring psychology and physics closer together in this way and to find a common ground for them. If we consider that Fechner's *Elements of Psychophysics* was published a few years before Mach came forward with his views (a work which according to Mach's own statement made a powerful impression upon him), then we may be justified in pointing to the impulse emanating from this work as the motive power which chiefly influenced Mach's thought in this direction. That Mach's speculations were crowned with success is perhaps mainly due to his early acquaintance with Kant's train of thought.

For, however the case may be, the fact remains that

Mach searched for a common view-point for both psychical and physical in essential methodological interests and found it soon after the appearance of Fechner's greatest work, and gave it to the world.

Mach's monism is not a monism of system but a monism of method.

Critical observation of the naturalist's activity formed the starting-point of his efforts in the general field of active philosophical work. Probably the first question that he put to himself was, What forms the particular subject of investigations in natural science? It was the answer to this which placed him in opposition to the traditional point of view of almost all physicists and most philosophers. The former had so accustomed themselves to the mechanical conception of all nature that they were hardly in a position to comprehend how any one could assign any other task to physics than the investigation of the distribution of matter and its operative forces, or in a later stage, of matter and energy (Maxwell), or of matter and motion (Kirchhoff). But philosophers had not unlearned the habit of looking with contempt upon the universe of phenomena since the time of the Eleatics; their glance remained rigidly fixed upon the "thing-in-itself." Then came Mach who explained as the object of the naturalist's occupation "sense-perceptions," a name which he chose under compulsion in lieu of a more suitable one, and which he later replaced by "elements"; for the sense in which he wished to have the word taken deviated to some extent from the customary usage. By the sound of the word we are inclined to put too much emphasis on the perceiving subject. But it was far from Mach's intention to emphasize this connection from only one point of view; on the contrary he saw at the time in sensations the material of the actual world. In this his fundamental views are essentially distinguished from those of idealistic philos-

ophy, Berkeley's among others. We may even call them realistic, but their realism indeed is essentially different from so-called philosophical realism. Then there are a number of philosophers, as for instance Stumpf, to whom the physicists are not physical enough, who never tire of declaring that on the other side of the world of phenomena there exists another, the actual world in which the laws of physics become valid, and which forms the end and aim of the physicist. Particularly, since the utterance of Hertz that it was enough for the physicist to possess a picture of the universe whose existence "in-itself" Hertz still clung to, though its investigation "in-itself" he had already recognized as superfluous, most of the physicists learned to be reconciled to Mach's fundamental conception; and it is to some extent amusing when philosophers in the alleged interest of physics designate something as absolutely necessary which the physicists themselves had previously learned to renounce, and prepare to instruct them upon the character of their science in which of course the philosophers themselves are only laymen.

We can say without fear of contradiction that to-day it is no longer seriously questioned that sense-perception form the object of the naturalist's research, that its aim is the construction of a legitimate connection between them, and that it is the task of scientific representation to give an abbreviated account of it by a reconstruction in thought.

But on the other hand sense-perceptions form also the object of psychological research. Consequently the substance does not differ in the two domains, but only the line of investigation. Since this, however, changes also within the realm of natural science, the boundary disappears which had existed until now between these two great departments of science, and also the contrast between the psychical and the physical. What we call physical and

psychical is constructed out of but one kind of elements. In the vast numbers of constantly changing elements we notice only certain relations. We find that a definite perception, which we designate perhaps as a table, seems to be always combined with certain tactile and muscular sensations which can be separated in some way; i. e., a definite group of *always* recurring sensations does not exactly appear, but the permanent element continues in a functional dependence in consequence of which still other elements appear joined to it in the case where there is a particular group of sensations. These centers of relation form what are commonly called "bodies," and *one* also of these centers or bodies is the ego.

The renowned Clifford, whose contributions to the theory of cognition have been too little heeded, also expresses this same thought in the following words:³ "My feelings arrange and order themselves in two distinct ways. There is the internal or subjective order, in which sorrow succeeds the hearing of bad news, or the abstraction "dog" symbolizes the perception of many different dogs. And there is the external or objective order, in which the sensation of letting go is followed by the sight of a falling object and the sound of its fall. The objective order, *qua* order, is treated by physical science, which investigates the uniform relations of objects in time and space. Here the word "object" (or *phenomenon*) is taken merely to mean a group of my feelings, which persists as a group in a certain manner; for I am at present considering only the objective order of my feelings. The object, then, is a set of changes *in* my consciousness, and not anything out of it. . . . The inferences of physical science are all inferences of my real or possible feelings; inferences of something actually or potentially in my consciousness, not of anything outside it."

³Lectures and Essays. London, 1901. Vol. 2, page 52.

As far as the ego is particularly concerned Mach points out, especially in his latest work, that the same thought-process which brings us to the concept of our own ego leads also to the concept of the ego of others. In a certain sense we are reminded too of Kant, and his attempt to refute idealism can be so interpreted or re-interpreted as to mean that the same processes lead to the formation of the concept of bodies as of the ego. In this way there has arisen from the original pursuit of a monistic point of view of the work of cognition among naturalists as well as psychologists a kind of philosophical idea which, however, many philosophers comprehend in their own way, i. e., as the foundation of a system. But it is characteristic of any system that it begins with some few self-evident propositions and descends from these to particulars. Mach's method was exactly the reverse and it is easy to understand how it was unavoidable that misunderstandings would arise from such a re-interpretation of his procedure.

But Mach's monistic point of view is not exhausted with the maintenance of the point of departure which has just been characterized; it is exemplified also in the fact that everywhere the ground is broken for a unification of phenomena. It is true that Mach dispelled the dream of a universal mechanical conception of physics, but only in order to gain a broader basis for the conception of the operations of nature as a whole, and, consequently, too, of those in living and animate organisms. His new work *Erkenntniss und Irrtum* is very significant in just this direction. The psychology of investigation is his subject; and what Mach strives in every way possible to set forth, what the treasure of his rich "direct" and "indirect" experiences suggest to him, consists in the fact that the activity of the investigator does not differ essentially from that of the thinker in the ordinary course of life; and that this in

turn is not essentially different from the animal's manner of proceeding; nor this again from the phenomena of inorganic nature. A noble feature of the unification of our world-conception permeates the whole. Here, too, Mach is far from advancing one of the philosopher's own claims to the statement of a perfected truth; on the contrary he says expressly in this place that "the acceptance of a soul that is free and operates without law will always be hard to refute, since experience will always produce an irreducible residuum of facts"; but "the free soul as a *scientific* hypothesis, and even a search for it" is a *methodological* aberration according to his opinion.⁴ Here too we come upon the emphasis of a methodological principle.

And if we scan the great methodological principles which Mach has established we shall find again throughout them the foundation of a monistic manner of thought. Formerly there was a dualism with reference to the conception of the sciences which were distinguished *a priori* and *a posteriori* as sciences of pure thought and of experience. Mach recognizes but one category. In his new work he refers even arithmetic to experience in contrast to a familiar utterance of Gauss. Not only the sources of science, however, are posited as everywhere the same (namely in experience) but also the degree of certainty knows only quantitative distinctions. There is no such thing as knowledge which is absolutely and unconditionally valid. The essence of science is the same everywhere, a means by which we are spared direct experience. Its value lies in this economy and in the possibility arising from it, of enlarging our knowledge. Science has received a new definition, a methodological definition; and the same is true of the principles of comparison, transformation and adaptation. Now if we look back the same fundamental thoughts return to us; the essential thing is doing and not

⁴ *Erkenntniss und Irrtum*, p. 25.

being. The task of science is "the discovery of identity amidst diversity" (Jevons); its aim, the aim of research, must be directed towards a possible unification. Different points of view are possible and useful, but ultimately there must be one from which we can survey the entire field of human activity.

DR. HANS KLEINPETER.

GMUNDEN, AUSTRIA.

EGYPTIAN MYTHOLOGY AND THE BIBLE.¹

THE points of contact between Judaism and the religion of Babylonia have frequently been mentioned by numerous writers, but the traces of Egyptian mythology in both Jewish and Christian Scriptures have not been so much noticed,² nor could they be till quite lately. It is only within the last few decades that students have been sufficiently well provided with mythological texts and commentaries to be in possession of the necessary material, thanks to the labors of Birch, von Bergmann, von Bissing, Breasted, Brugsch, Budge, Chabas, Devéria, Grébaut, Guieysse, de Horrack, Jéquier, Lanzone, Ledrain, Lefébure, Legrain, Lieblein, Mariette, Maspero, Moret, Naville, Piehl, Pierret, Pleyte, Renouf, Sharpe, Spiegelberg, Wiedemann and others. The relationship of Egyptian mythology to Jewish religion is too large a subject to discuss fully; *haec peritioribus relinquo*; so I only mention a few traces of Egyptian influence in the Old Testament, but there are many others. I will then point out the more numerous Egyptian touches in the New Testament.

I. OLD TESTAMENT PARALLELS.

(1) In Gen. i. 1, God is represented as having created the heaven and the earth. How He did this is not stated, but the narrative does go on to say how light was created,

¹ Hieroglyphs are omitted throughout this article because of the difficulty in the composing room.

² Lieblein, Völker, Groff and Cheyne have touched on the matter.

(verse 3) namely, by the Divine Voice; "God said, Let there be light: and there was light." This formula "God said" is repeated at each subsequent act of creation, all of which acts are described as being performed by the Divine Voice. Here certainly we seem to get an echo of the ancient Egyptian *maat kheru*, or *maa kheru*, power, the creative power of the divine voice, an epithet usually placed after the name of the deceased who became a god, and inadequately translated "true of voice."

This voice re-appears in St. John's Gospel as the Logos (Word), Chapter i. 3, "All things were made by him." The great demiurgic gods of Egypt, as well as the beatified deceased had the power of uttering creative words. M. Moret has shown³ that the goddess Maat is assimilated to the eye of Horus (the sun), and represents light. Her symbol, the ostrich feather, is read *shu*, "light." The gods created the world by a luminous emission from their eyes and a sonorous emission of their voice. Thus light created reality. The offering of Maat to the god by the priest-king, a ritualistic scene very commonly portrayed and of the highest importance, is to give the god all which really lives; it is to put him in possession of all the material reality which he himself created and is not of an ethical significance. In fact, it is to offer the god to himself, an idea common to religions. [Moret.]

"Men came from Horus' two eyes; the gods were made manifest by his mouth." "Gods are manifested when he (the demiurgic god) speaks."

The word is made flesh according to the Egyptians by the assimilation of the sepulchral meal or offering (*per kheru*) to what comes out of the mouth of the god. Therefore the words *maat kheru* or *maa kheru* mean to have a creative voice like the gods, and it does not mean merely "true of voice" as usually translated.

³ *Le rituel du culte divin Journalier en Egypte*, 1902.

Dr. Breasted in his article in *The Open Court*, 1903, "The Philosophy of a Memphite Priest," commenting on the cosmological slab in the British Museum, sums up the Egyptian philosophical conception of the world thus: "Assuming matter, all things first exist ideally in the mind; speech or its medium, the tongue, constitutes the channel, as it were, by which these ideas pass into the world of objective reality." M. Maspero in a review of the same slab writes, "Things and beings 'said inside,' (i. e., thought), only exist potentially; in order for them to reach real existence it is necessary for the tongue to speak them 'outside,' and to solemnly proclaim their names. Nothing exists before having received its name *out loud*." This conception of producing existence by the voice is excessively ancient and is found in the Pyramid texts.

It is remarkable that the Egyptian name of Joseph, Gen. xli. 45, *Zaphnath-paaneah*, "The god spake, and he lives," seems to embody the tradition of creation by the divine voice. It is a well-known type of name, not ancient, used in the XXVIth Dynasty; Krall was the first to point out in 1886 the connection of *Zaphnath-paaneah* with this type of name. We find various gods' names used, but all the deities are of the first rank. Thus we have,⁴ "Horus spake, and he lives"; "Isis spake, and he lives"; Mut spake, and she lives," (woman's name); "Menthu spake, and she lives," (woman's name; and similarly compounded names with Amen, with Ptah, Thoth, Khonsu, Bast and Anher or Onouris, (a form of Shu).

(2) Genesis i. 5, "And the evening and the morning were the first day."

The night also preceded the day in Egyptian cosmogony. "Tum, Osiris, Sokar, Tanen and Har-ur, who symbolized the setting sun, are anterior to the rising sun.

⁴ See Lieblein's *Dictionnaire de noms hiéroglyphiques et supplément*.

Hathor, the receptacle of the nocturnal sun, brings forth the rising sun."

(3) The formula, often used in the Bible (Neh. ix. 6) "Thou hast made heaven, the heaven of heavens, with all their host, the earth, and all things that are therein, the seas, and all that is therein" . . . , and (Ps. cxlvi. 6) "Which made heaven, and earth, the sea, and all that therein is" . . . , and (Is. xxxvii. 16) "Thou hast made heaven and earth"; Acts xiv, 15, and Rev. xiv. 7, have almost the same as that in the well-known hymn to Osiris, "He has made this earth with his hand"—another version of the creation—"its waters, atmosphere, vegetation, cattle and all birds, all fish, and creeping things."

A more elaborate parallel is found in a hymn to the Divinity of the time of Rameses IX, published and translated by M. Pierret:

"God, who has suspended the heaven and causes his disk to sail in the bosom of Nut, and guides it in the bosom of Nut, in his name of Ra; he has formed gods and men and all their generations; he has created all countries, both soil and liquid element, in his name of Creator of the world; he has brought water from its source; he gives growth to nutritive plants and produces the nourishment which proceeds from them, in his name of Nu [which here means the Nile]; he gives movement to the waters of the sky; he makes the water fall on the tops of the mountains, in order to make men live, in his name of Author of Life" . . .

Again, in a hieratic papyrus in the Cairo Museum we read in a hymn to Amen-Ra, that he is "Maker of grass for the cattle. . . of fruitful trees for men, causing the fish to live in the river, the birds to fill the air; giving health to those in the egg; feeding the bird that flies giving food to the bird that perches; to the creeping thing

and the flying thing equally; providing food for the rats in their holes,"....

In fact so persistent is this very ancient form of address to the Almighty that it is even found in an Egyptian Christian prayer of the third or fourth century⁵ (in Greek), "O God Almighty who hast made heaven and earth, the sea and all that in them is, help me, pity me, wipe out my sins, save me now, and in the future age, through our Lord and Saviour Jesus Christ, through whom is glory and power, for ever and ever, Amen." In the Book of the Secrets of Enoch, which Dr. Charles says was written in Egypt, Enoch teaches his sons not to worship "vain gods who did *not* make heaven and earth."

(4) Exodus. At the Provincial Congress held at Lyons, 1878, M. Lieblein approximates Yahveh to the Egyptian god Khepera. These are his arguments: "The Hebrews did not know Yahveh before the time of Moses; Khepera was a Heliopolitan god, and Moses received his education at Heliopolis and is called by Manetho 'the Heliopolitan Priest'; the name of the god Khepera means 'to exist,' 'he who is,' and the name Yahveh has the same signification, 'he who is.' M. Lieblein also gives an illustration of the arrangement of the interior of the Egyptian ark on the processional boat, which is precisely similar to that of the Hebrew ark, as described in Ex. xxv. 20-22.

(5) In Neh. ix. 6, the *oneness* of God is insisted on; "Thou, even thou, art God alone." This also is paralleled in a hymn to Amen - Ra which uses these expressions, "Form unique; maker of all things which are; the one who is alone; producer of existences; numerous are his names." Beautiful things are said of the Divine Creator by the ancient Egyptians. "What is, is in his fist; what is not is in his side"; "He traverseth eternity"; "You cannot

⁵ *The Oxyrhynchus Papyri*, Part III. 1903. No. 407.

see him"; "Thy rays are from a face which is not known"; "He is for ever"; "He has spread out the heavens, and put the earth underneath"; "Great God of primæval time."

We do not call the Egyptians monotheists, but henotheists; they were capable of thinking of one god at a time, and so making him the only one for the time being.

(6) Job xxix. 6. "When I washed my steps in butter." At the Congress of the French Orientalists held at St. Etienne, 1875, Dr. A. Wiedemann remarked that the whole Book of Job displays an Egyptian influence. He refers especially to the Egyptian touch in this passage. The English translation "butter" is, according to Gesenius, better translated "*milk*." This too makes better sense.

On a stele in the Egyptian museum of Florence, we read, "may Isis give you milk, so that you may wash your feet on the silver stone and the pavement of turquoise." Dr. Wiedemann notices that while this expression (to wash your feet in milk) in Job's mouth only means a state of happiness, it had a religious significance in ancient Egypt. Owing to the soiling of the feet by the earth, the skin of the soles was removed after death, and the wound washed in milk, as if the deceased were alive. The "silver stone and the pavement of turquoise" doubtless formed the floor of the Hall of Justice, though unfortunately we do not possess a detailed account of it. Besides these remarks of Dr. Wiedemann, an interesting comparison may be made of the same chapter of Job, verses 11-17, and a portion of the hieroglyphs on the sarcophagus of Unnefer, a royal scribe and priest (published by Karl Piehl, and now in the Cairo museum). I give the text in English, from Karl Piehl's translation in French of the hieroglyphs:

"When the ear heard me, then it blessed me; and when the eye saw me, it gave witness to me. Because I de—

livered the poor that cried, and the fatherless, and him that had none to help him. The blessing of him that was ready to perish came upon me and I caused the widow's heart to sing for joy. I put on righteousness and it clothed me: my judgment was a robe and a diadem. I was eyes to the blind, and feet was I to the lame. I was a father to the poor, and the cause which I knew not I searched out. And I brake the jaws of the wicked and plucked the spoil out of his teeth."

Unnefer after invoking the gods is made to say, "I am a man devoted to his father, the favorite of his mother, the friend of his brothers. I have not done what ye (the gods) hate on earth. Give me bread in the city of eternity, and water in the perfect land which is in Neferkhert. For I am a man by my actions, (?) I am true of heart, without weakness; kindhearted, obeying God's will. I am a favorite in my city, a benefactor of my country, mild towards every one. I am a man of vigorous build, of fine countenance, amiable and contented. I am courageous in the moment of distress, gentle of speech, perfect in words. I am a fertile region to him who is in poverty, and every one has confidence in me. I have entered the way of moderation. I am efficacious in my words, wise in counsel; a good guide. I protect the weak against the strong, so as to facilitate the passage of everybody. I am a perfect noble, doing the will of the gods. I am the friend of my comrades. I am a liberal man to the poor, without boasting of what I have given. I am the friend of truth, the enemy of lies, a man who knows what God has forbidden"...

This diffuse, childlike description of a good man compares as regards morality very favorably with Job's literary, worked-up, more artificial expressions—Unnefer's sayings are of a milder character than Job's. There is nothing in them about breaking the jaws of the wicked.

He is also on his guard not to boast of what he has given, which Job certainly does.

Though Unnefer's sarcophagus is of late date, the ideas he uses are very ancient.

(7) Ps. cxi. 10. "The fear of the Lord is the beginning of wisdom." See also Job xxviii. 28, Prov. i. 7 and ix. 10. This is very like "The beginning of wisdom is the way of Amen," a sentence which occurs in a hymn to Amen in the Anastasi Papyrus in the British Museum. Literally it is "The beginning of wisdom is the *water* of Amen." The Nile was the great highway, hence "the water" was used to signify "the way," i. e., "will, command, or rule."⁸

(8) Ezekiel (xviii. 7) in his description of the just man says, "He hath given his bread to the hungry, and hath covered the naked with a garment."—The just man (according to Egyptian religion as recorded in Chapter CXXV of the Book of the Dead) who has been purified after death in the Hall of Maat, also says that he has given "bread to the hungry; water to the thirsty; clothes to the naked; a boat to the shipwrecked." The boat, so indispensable to a dweller on the Nile, but absolutely useless to a Jew, with the dried-up river courses of his native land, has disappeared in Ezekiel's list. Ezekiel has been called a "literary" prophet, and he was essentially a "scholar"; so it is not surprising that his imagination should have been tinged with foreign ideas and expressions, as we also see in his vision. I refer to this latter when commenting on Revelations.

As regards the Egyptian analogies in the Gospels, I have already mentioned the connection of the Logos (word) of St. John with the Egyptian *maat kheru* power. The virgin birth is paralleled in the details of the birth of Amenhotep III depicted on the walls of the temple of Amen at Luxor, where, among other scenes, Amenhotep's

⁸ Goodwin, *Records of the Past*.

mother, Mut-m-ua, is represented listening to Thoth, the master of divine words.⁷

The innumerable figurines of Isis suckling the infant Horus are too well known to require a detailed account of them. The blood of Isis is mentioned in Chapter CLVI of the Book of the Dead as a protection to the deceased, and her amulet, called the buckle(?) is very common, and



THOTH ADDRESSING MUT-M-UA.

From *Mission archéologique française au Caire*. Vol. XV, Plate LXIX.

often made of red jasper, or of carnelian, to represent the color of blood.

It is in Revelations that so many Egyptian traits occur, as well as in the book of Ezekiel, and the Egyptian element in both may have caused the difficulty of getting these works into the canon. Whoever wrote the Apocalypse seems to have been a Christianized Jew, acquainted

⁷ Noticed by Sharpe in his little book *Egyptian Mythology and Egyptian Christianity*.

probably with the Book of the Dead and with the symbolism engraved on Egyptian scarabs.

II. NEW TESTAMENT PARALLELS.

The Jews, who were totally unable to express themselves in pictorial and plastic art, which was forbidden them by their religion, poured all their genius into their sacred writings. The very opposite of the Jew, the ancient Egyptian was particularly skilful in sculpture and wall-decoration. But the peculiar formation and position



ISIS NURSING HORUS.

of the Nile valley necessarily reacted on the Egyptian imagination in various ways, and made the theology of the people too full of local color to be a world-religion; especially as the Egyptians were a non-maritime and a non-colonizing power, and so did not spread over the world.

An especially Egyptian touch in the Apocalypse is the great number of animals mentioned. Christianity is

not without its animal symbolism, of which the most prominent examples are the Lamb of God and the Dove of the Holy Spirit. Who that has seen the altarpiece of "The Adoration of the Lamb," at St. Bavon, Ghent, could say that symbolic animal worship was not a feature of Christianity? Even the Protestant publication of "The Temple Bible" has a picture of a Lamb on its cover.—But besides animals, M. Lefébure has shown that the Egyptians deified all the aspects of nature; the atmosphere, water, dew, earth, wind, the Nile, sky, heat, drought, damp, cloud, tempest, moon, stars, sun. The same kind of treatment occurs in Apocryphal and Gnostic Acts, where the throne and the cross are deified, and the cross speaks.

The following imagery used in Revelations can be paralleled in Egyptian mythology:

- (1) Rev. i. 8, Alpha and Omega.
- (2) Rev. i. 13, The golden girdle.
- (3) Rev. i. 14, The wool-white hair.
- (4) Rev. ii. 11, The second death.
- (5) Rev. iv. 6, The sea of glass.
- (6) Rev. iv. 6, The four beasts full of eyes.
- (7) Rev. vii. 1, The four angels at the four corners.
- (8) Rev. vii. 17, The tears wiped away.
- (9) Rev. ix. 10, The locusts with scorpion tails.
- (10) Rev. ix. 19, Lion-headed horses with serpent-headed tails.
- (11) Rev. xix. 12, Many crowns.
- (12) Rev. xx. 1, 2, 3, Chaining the dragon.
- (13) Rev. xx. 10, 11, 12, The lake of fire.
- (14) Rev. xxi. 18, The wall of Jasper.

I. Alpha and Omega.

Rev. i. 8, "I am Alpha and Omega, the beginning and the ending, saith the Lord, which is, and which was, and which is to come" See also Is. xlv. 6, "I am the first

and I am the last," and Is. xlviii. 12. This is not unlike the beginning of Chapter XVII of the Book of the Dead, as translated and noticed by Renouf: "I am he who closeth, and he who openeth, and I am but One." But the texts which contain this opening phrase do not agree, and this sentence is absent from the primitive recension on the walls of Horhotep's tomb. The XVIIth Chapter is one of the most remarkable and ancient chapters in the Book of the Dead, where the deceased assimilates himself to the Deity as primordial God and Creator (Pierret). It was so obscure to the Egyptians themselves, that it is full of their notes and explanations, and questions, such as "What is that?" mixed up in the text.

The latter part of the much quoted sentence of Rev. i. 8, "Which is, and which was, and which is to come" also seems to have an Egyptian analogue, as the Egyptians divided mankind into the *Pait*, the past, or dead; the *Rechit*, or present, living generation; and the *Hamemet*, the future unborn generation. On an obelisk of the XIIth dynasty, at Alnwick Castle, Osiris is called "Lord of Being and Not-being," i. e., of everything.

(2) *The Golden Girdle*, and (3) *The Wool-white Hair*.

Rev. i. 13, 14. "One like unto the Son of man, clothed with a garment down to the foot, and girt about the paps with a golden girdle. His head and his hairs were white like wool"

One of the vignettes in the beautifully illustrated papyrus of Ani, (c. 1500 B. C.) in the British Museum, has a representation of Ani, the man for whom the papyrus was made, being led into the presence of the enthroned Osiris by the god Horus, who acts the part of *Psychopompos*. Ani wears his hair in jet-black curls. He is "girt about the paps with a golden girdle," and is in a respectful and timorous attitude, slightly bending forward. In the front of this vignette is another representation of



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HORUS LEADING ANI BEFORE OSIRIS.
From the *Papyrus of Ani*, Plate IV.

Ani, after his beatification, where he kneels before Osiris in the attitude of prayer and supplication. Ani wears the same white and golden garment "down to the foot," but his hair is now "white like wool"; it is adorned with a cone the significance of which is not understood.

There is also a representation of Queen Thiti beatified (XVIIIth dynasty), crouching on a red cushion, and naked except for jewelry, with a similar head "white like wool." This is adorned with an *uraeus*, serpent, the sign of the queen's rank.

(4) *The Second Death.*

Rev. ii. 11. "He that overcometh shall not be hurt of the second death."

The "second death" or annihilation is frequently mentioned on Egyptian coffins. On that of the lady Tauhert, a singer of Amen, (translated by Piehl,) is written "O mother Nut (the sky) who spreadeth her wings over me, grant that I may be among the stars Achem-sek, and among the stars Achem-ured; that I may not die the second death." On the coffin of Pa-du-pep is written "I make thy way among the stars; thou shalt not die for ever." On the coffin of general T'aho, "Thou shalt not die the second death." The Egyptians called the blessed dead "the living ones," as is written on the coffin of Nesi-pa-ur-shef,⁸ where he invokes (as well as the gods) "Ye resting ones who are in Duat, ye who repose, ye mighty souls, ye *living ones* who are in the grave, . . . come ye, protect the Osiris, the divine father of Amen Ra, king of the gods, Nesi-pa-ur-shef, true of voice (having the creative voice). Grant that he may rest as those who are resting. . . . May he come and go without repulse at the doors and secret pylons of Duat. May his soul come out and do as he likes. May he refresh himself in the beams of the disk," etc.

⁸ In the Fitz William Museum, Cambridge, and translated by Dr. Budge-

The *mit* are the dead, those who have died the second death, i. e., annihilation. (Renouf.)

The second life is the logical consequence of not dying the second death. This also is frequently referred to. An instance is on the obelisk already mentioned, where Osiris is glorified by the deceased for giving the "delicious breath of life" to the royal son, Beba, in his renewed, or second life. In fact, this expression on certain monuments replaces, after the name of the deceased, the more usual *maat kheru*. In the CXXXVth Chapter of the Book of the Dead, it is written "If this chapter is known to the deceased, he shall not die a second time."

(5) *The Sea of Glass, or Hyaline Sea.*

Rev. iv. 6, "And before the throne a sea of glass like unto crystal"; and (Rev. xxii. 1) "A pure river of water of life, clear as crystal proceeding out of the throne of God and of the Lamb."

Dr. Budge has drawn attention to the remarkable fact that the throne of Osiris, in a vignette of the Hunefer papyrus (c. 1370 B. C.) is represented as placed on water. The Book of the Dead mentions the water beneath the throne of Osiris, in Chapters CXVII and CXXV, (Renouf's translation and notes.)

Chapter CXVII, "I am he who produceth the water which balanceth his throne, and who maketh his way from the great valley." Here the deceased is identified with the Nile and its inundation.

Chapter CXXV, "But who is he whose roof is of fire, and whose walls are living *uraei*, [this refers to the shrine where Osiris sits on his throne] and the floor of whose house is of running water? Who is it? It is Osiris."

There seems to be an echo of this sacred water beneath the throne in the third vision of the "Shepherd of Hermas," where a tower—the Church—is built on water.

Hermas asks, "Why is the tower built upon the water?" He is told "Because your life is and shall be saved by water" (baptism).

Victorinus, Bishop of Petavio (martyred 303, A. D.) also allegorized the sea or river proceeding from out of the throne of God as symbolic of the gift of baptism.

According to the chronicles of Jera'hmeel the throne of glory is so important that it was one of the seven things created before the world. The earth was made from the snow beneath the throne of glory.⁹

(6) *The Four Beasts Full of Eyes.*

Rev. iv. 6. "And in the midst of the throne and round about the throne were four beasts full of eyes before and behind. And the first beast was like a lion, and the second beast like a calf, and the third beast had a face as a man, and the fourth beast was like a flying eagle." (Compare also Ezekiel's vision, Ez. i. 4).—Sir J. G. Wilkinson, as long ago as 1841, suggested a connection between the four beasts and the four funerary genii of the Egyptians which were also near the throne. Their names are (1) Amset or Mestha, (2) Hapi, (3) Duamutef, (4) Qebhsennuf. The first is represented man-headed, the second do (or ape-) headed, the third jackal-headed, the fourth hawk-headed. This order of mention is almost always adhered to. These four genii presided over the intestines and interior organs of deceased persons, and four goddesses Isis over Amset, Nephthys over Hapi, Neith over Duamutef, and Serq over Qebhsennuf acted in consort with them. As Dr. S. Birch wrote "These genii represented the four cardinal points of the compass, and the deposit of the viscera symbolized their dispersion to those cardinal points. The viscera, according to Egyptian notions, being the

⁹ In Hastings' *Dictionary of the Bible*, 1902, Vol. IV, p. 425, it is stated that "The sea of glass has no exact parallel in previous or contemporary literature." (!)

source of all evil to man;" or as Professor Wiedemann expresses it, "The four genii had charge of the viscera of the dead, and were bound to appear at the judgment, because it was not the divine ego of a man which sinned, but only his internal organs." Therefore the four funerary genii (also called the children of Horus, the four



QEBSENNUF. DUAMUTEF. HAPI. AMSET.

FOUR FUNERARY GENII:

Lenormant's *Histoire ancienne de l'orient*, III, 244.



FOUR GENII ON THE ALTAR.

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Sharpe's *Egyptian Mythology and Egyptian Christianity*, p. 52.

children of Osiris, the four genii of the Amenti) very nearly always appear in the scene of the *Psychostasia*, standing on, or sometimes over, the lotus flower, the symbol of the resurrection, which was placed in front of the enthroned Osiris.

In the papyrus of Neb-Qed, in the Louvre, their names are written under the throne, instead of their figures being drawn. These four genii are, as Sharpe says, "The friends and advocates of the trembling sinner," and Sharpe gives an illustration (here reproduced) of a scene on a funeral stele in the British Museum, of the date of Rameses II, where the four genii appear on the altar before the seated Osiris, their heads being turned towards the suppliant, as if they had been put, or had put themselves there as an offering, instead of the usual lotus.

The inhabitants of the Mesopotamian valley, as well as those of the Nile valley, had their human-headed bulls and lions; and this similarity of symbolic animals who



VIGNETTE OF DUBLIN PAPYRUS.
Nephthys, Osiris, Isis.

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were intermediary beneficent beings between God and man, supports the current theory, that Egypt was civilized from Babylonia. Mr. Collingwood¹⁰ who has studied the question of the four beasts, writes that "St. John's description of them is not that given by Ezekiel, and shows knowledge independent of canonical Scripture." This independent knowledge he ascribes to the Chaldæan astrologers. But though it is possible that Ezekiel, whose vision is dated from the river Chebar (593-592 B. C.) was influenced by the Chaldæan form of the genii, St. John is much nearer the Egyptian form, for he leaves out the wheels, and retains Egyptian traits, such as the four beasts

¹⁰ *Astrology in the Apocalypse*, 1886.

being "round about the throne," for they are always placed very near the enthroned Osiris, in front of him. But in one Egyptian point Ezekiel's description is more exact, namely in the *order of mention* of the genii. In Ezekiel the *faces* of the four living creatures are (1) man, (2) lion, (3) ox, (4) eagle. Observe the order; it is preserved in the mention of the four funerary genii or children of Horus: (1) Amset, man headed; (2) Hapi, dog-headed; (3) Duamutef, jackal-headed; (4) Qebhsennuf, hawk-headed. That in the course of so many centuries the dog has become a lion, the jackal an ox, and the hawk an eagle in the Hebrew version is not surprising. But it



GENII AROUND A COFFIN.

Papyrus in Trinity College, Dublin.

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is surprising that the order is so strictly kept. The order in Revelations is (1) lion, (2) calf, (3) man, (4) eagle. Thus both books seem to have access to Egyptian symbolism, as regards the mention of the four beasts and other passages; the Apocalypse is full of it.

In the XVIIth Chapter of the Book of the Dead we are told of the "seven luminous ones who follow after the confined one," i. e., Osiris. Four of these seven are the four genii, and they are represented in the vignettes of papyri with their names often written over them, standing by the "confined" deceased. These seven luminous ones are the constellation of the Great Bear, or the "Thigh," as the Egyptians called it. In the papyrus of Ani, it is

called "The seven bright ones who follow their Lord." Doubtless the four beasts had an astronomical origin. The detail "Full of eyes before and behind" represents the starry sky.¹¹ It has been suggested by Mrs. Nuttall that Osiris was originally the pole-star, and as sidereal worship seems to be more archaic than solar worship, her view seems quite possible.

The remote antiquity of the four genii, or children of Horus is fully certified to be 5,000 or more B. C.; for the genii are frequently mentioned in a fully developed form in the Pyramid Texts, which are considered by M. Ma: pero to be pre-Mena. In the text of Pepy I, of the fourth millennium B. C. we find "O children of Horus, carry your father, this Osiris Pepy (the deceased king); guide him, make him survive, make him open his mouth, and hold himself upright." This shows that the worship of the four genii, as powerful agencies in favor of man after death, was even fully developed in the fourth millennium B. C. and formed part of the most ancient mythology of the Egyptian religion.

The four genii are adopted into apocalyptic Judaism as well as into Christianity, as is seen from the Book of Enoch (first and second centuries B. C.), xl. 2, 9: "And I looked, and on the four sides of the Lord of Spirits I saw four presences.... I asked the angel of peace.... 'Who are these presences?'.... And he said to me, 'This first is Michael,¹² the merciful and long-suffering; and the second who is set over all the diseases and the wounds of the children of men is Rufael; and the third who is set over all the powers is Gabriel; and the fourth who is set

¹¹ See Gunkel *Zum religionsgeschichtlichen Verständnis des Neuen Testaments*, which appeared in English in *The Monist*, 1903. Stars are conceived as eyes of the Divinity. The Egyptians called the sun and moon "The eyes of Horus". "The two eyes illumine the world."

¹² Canon Cheyne says of this great archangel, that he "has the work of subduing the *evil principle* at the end of the present age." In Chapter XVII of the Book of the Dead the four funerary genii protect Osiris against "*evil principles*."

over the repentance and hope of those who inherit eternal life, is named Fanuel' " (afterwards Uriel).

In Enoch xc. 21, there is a reference to seven chief angels as the "seven first white ones," which agrees with the "seven luminous ones" already mentioned. In Isaiah



THREE EVANGELISTS: MATTHEW, MARK, AND LUKE.

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A plinth of the twelfth century in the Campo Santo, Pisa. The fourth side is against the wall, and St. John seems never to have been represented in this group.

lxiii. 9, we read, "And the angel of his presence saved them; in his love and in his pity he redeemed them, and he bare them and carried them all the days of old," thus recalling the benefits of the four genii to mankind.

The well-known symbols² of the four Evangelists are taken from the combination with the Egyptian order of hieroglyphs: St. Matthew, man-headed; St. Mark, lion-headed; St. Luke, ox-headed; St. John, eagle-headed. Here we have the last form of the gens of Amenti.

The four gens also very frequently appear on coffers, some Egyptian, and on wooden painted mummy cases; also on painted wooden staves of Ptolemaic date. The mummy cases date from about B. C. 1500 to Roman times. In the temple of Queen Ma-kara of the XVIIIth dynasty, are four remarkable specimens of the gens:

Hesha, or Hesi, says: "I am Mesha thy son who



THE FOUR GENS SHOWN IN AN ANCIENT COSS. HEMSBY, NORFOLK-
SHIRE. 3849

Turning's Symbols and Emblems of Early and Medieval Christian Art, p. 108.

loves thee: Lo! I have come in peace to make thee receive incense, oil, stuffs, offerings of cakes and herbs. O Osiris, divine wife, Ma-kara," etc.

Hapi says: "I am Hapi thy son who loves thee; verily I am come in peace to make thy soul come out, so that it may hover about any place it likes. O divine wife," etc.

Duamutef says: "I am Duamutef thy son, who loves thee; I am come to make thee go out and come into Neter-khert; may thy soul not be separated from thy body O Osiris, divine wife," etc.

Qebhsennuf says: "Verily I am come to make thee

² It is curious that "these symbols of the four Evangelists were in their combination held to be symbolical of the Redeemer, in the fourfold character then universally assigned to Him, as man, as king, as high-priest, and as God." Mrs. Jamieson, *Sacred and Legendary Art*.

reach heaven; to cross the celestial abyss, and mingle with the stars, O divine wife," etc.

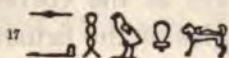
On the black basalt sarcophagus of the lady Tent-Hapi, in the Louvre, the four genii appear; Amset brings her *ka*,¹⁴ ego, double; Hapi brings her *ab*,¹⁵ heart; Duamutef brings her *ba*,¹⁶ soul; Qebhsennuf brings her *sahu*,¹⁷ or mummified body.

In the tomb of Neb-unnef (XIXth dynasty) Amset offers him his *ka*; Hapi offers him his *ab*; Duamutef offers him his *ba*; but Qebhsennuf offers, instead of the *sahu*, the deceased's *khaibit*, or "shadow," which has been explained fancifully as the light in heaven of the soul on earth; compare the pictorial halo of Christian saints.

On the sarcophagus of Hor-sa-Isis, son of the lady Ta-du-a (XXth dynasty) in the Bibliothèque Nationale, this speech of Amset is written: "O Osiris, Hor-sa-Isis, creative of voice, blessed one with the great God, Lord of Heaven, over all the gods; (who art) living as a god in Him, I am Amset, I am thy son Horus, who loves thee, I protect thee every day; I have made thy house (tomb) strong. . . . by order of Ptah; I have repulsed thine enemies for thee as I repulsed Apap from Ra. Thoth subdues thine enemies; Anubis makes whole thy maladies, O Osiris!"

On the curious mummy-case of a lady, Mut-shep-n-Chonsu, daughter of Auf-kat, in the Louvre, the four genii are represented standing in the folds of a large serpent, which is spitting out fire at the enemies of Ra, and of the deceased.

On the mummy case of the daughter of Dioscoros (Bibliothèque Nationale, second century A. D.) in order to help her resurrection, the four genii are found; also the god Anubis and two groups of Isis suckling the infant



Horus. These groups symbolize the new life promised to the daughter of Dioscoros. Written in gilded uncial letters on her mummy are the words

ΔΙΟΣΚΟΡΟΥ ΕΥΨΥΧΙ,

"O daughter of Dioscoros, farewell!"

The four genii are conspicuous figures in the Rhind Papyrus, translated by Dr. Birch. The man for whom the papyrus was made, Menkara (born B. C. 68) is laid out as a mummy in the Pool of Chons, surmounted by the sacred eye. Over him are the genii, in abnormal order, Khebsennuf, Hapi, Amset, Duamutef. Of the mummy it is said, Amset rejoices to embalm him; Hapi delights to obliterate his faults; Khebsennuf rejoices he has passed from the place of preparation. In the fourth Plate the four genii adore Osiris and say, "We come to our father (Menkara) when he approaches the underworld. He did no evil in his day. . . . We declare his goodness before the Lord of the Empyrean region. He listens to our words, the Lord of the West."

The four children of Horus are found on the linen stuccoed disk called "Hypocephalus," a mystic amulet full of elaborate animal imagery typifying the resurrection.

The immense length of time during which belief in the genii endured is very remarkable, and shows the feeling of timidity in the ancient Egyptians, and how much they dreaded the perils which were awaiting them after death.

(7) Four Angels at the Four Corners of the Earth.

Rev. vii. 1. "Four angels standing on the four corners of the earth." These angels recall to one's mind the funerary genii, who, as has been already mentioned, represented the cardinal points of the compass. According to one Egyptian version of the creation, the genii posted themselves at the corners of the earth and received the four angles of the firmament (imaged as a ceiling of iron

on which the divine ocean rolled) on the point of their
scepters. Therefore they are called in the Book of the



LETTING FLY THE GEESE.

From Lepsius, *Denkmäler aus Aegypten und Aethiopien*.

and "The four glorious ones who are conspicuous by
their scepters." They are also called (Chapter XVII)

"The pillars of the god Shu." In Chapter LX the deceased prays that he may have power over the divine beings "who have mighty arms in their shoulders," i. e., those who uphold the sky, the four genii, or children of Horus.

The hieroglyph for storm, tempest, etc., shows the sky falling away from the four scepters, its supports. At the Sed festival, or festival of the Royal Fillet, identified with the *uraeus* which adorned the king's forehead, (coronation festival) four geese, which personified the genii were let fly to the four corners of the horizon; each goose was apostrophized thus: "Go to the north¹⁹ (to the south, east, west) and say to the gods of the north (of the south, east, west) that Horus (the king) son of Isis has assumed the great double crown and that the king of the south and north (here his name is given) has taken the double crown (of Egypt)."

(8) *Tears Wiped Away.*

Rev. vii. 17. "And God shall wipe away all tears from their eyes." And Is. xxv. 8.

This beautiful expression is paralleled²⁰ in the Hymn to the Nile, the work of the scribe Ennana, which has often been translated, and most recently by M. Guieysse, in the *Recueil*, 1900. In the sixth stanza of this hymn we read, "Thou driest the tear of every eye," literally "is drunk the water of eyes all by him (the Nile)."

(9) *Scorpion Tails.*

Rev. ix. 10. (The locusts) "had tails like unto scorpions, and there were stings in their tails."

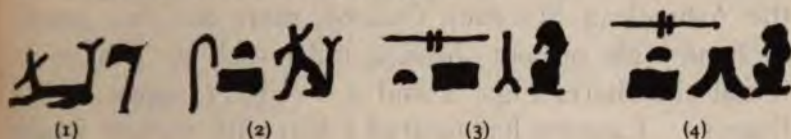
Scorpion or forked tails are rare in ancient art. There is a deity with a forked tail on a broken seal, from Knossos,

¹⁹ It is remarkable that of the four horses of Zechariah's vision (chap vi 6) it is mentioned that the black horse goes to the north courts and the white follows, and the grisled horse goes towards the south.

²⁰—The Rev. F. C. Cook has noticed the connection in *Records of the Past*, Vol. IV.

Crete. Also the god Bes in Dorow and Klaproth's *Antiquités Egyptiennes*, Plate XIV, No. 721, is figured with a forked tail, and holding a drinking tube inserted in a large amphora.

The pre-Mena god Set is represented in hieroglyphs as an animal with a forked tail thus:



How important the forked tail was, is shown by its being placed separately from the animal's body.

That there was a connection between Set and the scorpion is shown by a rare scarab in the Edinburgh Museum (broken).

On the stele of the year 400, found in Tanis, Set wears



DEITY FROM CRETE.
Publ. by Dr. A. J. Evans.

BES.
D. and K. XIV, 721.

SET.
Edinburgh Museum.

a long pigtail, ending in a fork, which appears to issue from the god's crown, and two small forks are over his forehead.

(10) *Lion-headed Horses with Serpent-headed Tails.*

Rev. ix. 19. "The heads of the horses were as the heads of lions. . . . for their power is in their mouth, and

in their tails; for their tails were like unto serpents, and had heads, and with them they do hurt”

Animals with serpent-headed tails, and serpents coming out of their limbs and bodies are a peculiarity of Egyptian scarabs, but though more common than examples of scorpion or forked tails, they are not very common. In the Ashmolean Museum, Oxford, there are two scarabs of lions with serpent-headed tails, such as I have not found elsewhere, Figs. 1 and 2. (Fig. 1 seems to be a lioness). Lanzone has figured a lion with serpent issuing from its foot²¹ and also a horse with a serpent springing from his hoof, Fig. 3.

This horse, from the accompanying hieroglyphs was



FIG. 1.



FIG. 2.



FIG. 3.

know to be a symbolic representation of Pharaoh, for the inscription runs: “Beautiful lord of the two lands.” This is the common formula used for the king on scarabs. The *uraeus* serpent is the symbol of the divinity and royalty, which were fused in the Egyptian imagination. Another quadruped found with serpent issuing from its foot is the cat, Fig. 4, (Ashmolean). Dorow and Klaproth have also figured a similar one. These cats with *uraei* are rare. Professor Petrie has figured a cat wearing the double crown of Egypt, Fig. 5; the ostrich feather behind is a divine symbol. Of birds, the hawk, representing Horus, wearing the crown of Lower Egypt, Fig. 6 (Queen’s College, Oxford, Collection), and Amen Ra as a goose, Fig.

²¹ Terza dispensa, page 272, of his *Dizionario di mitologia egiziana*.

7, (*Naucratis*, Vol. I) are found with serpents issuing from the foot.

Of gods, Set and Bes are distinguished as being depicted with a serpent, or serpents issuing from their body, or from their limbs, or else the serpent is stationed in the field beside, or behind them, see Fig. 8 (Louvre) of Set, and Fig. 9 of Bes (Lanzone).

There is also an Etruscan example of a serpent-headed tail on an ancient vase.



FIG. 4.



FIG. 5.



FIG. 6.



FIG. 7.



FIG. 8.



FIG. 9.

(11) *Many Crowns.*

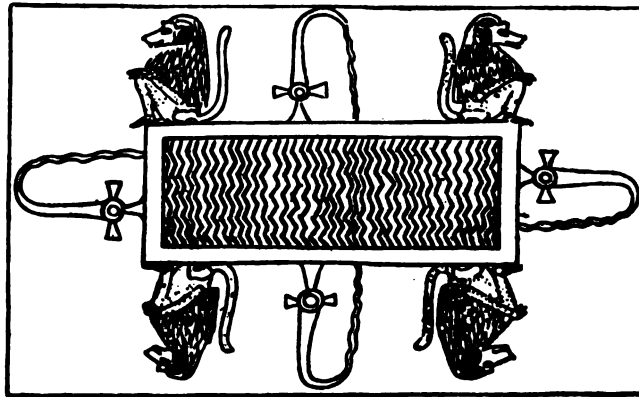
Rev. xix. 12. "And on his head were many crowns."

The Pharaohs wore the two crowns together of North and South Egypt, combined at an early date, and I am not aware that the kings of any other ancient country wore more than one crown at a time. Like the feathers of Amen and the plumes of Osiris, these two crowns, and other insignia of the gods and goddesses, became amulets, and models of them in faïence are to be found in museums.

(12) Chaining the Dragon.

Rev. xx. 1, 2. "And I saw an angel come down from heaven, having the key of the bottomless pit and a great chain in his hand. And he laid hold on the dragon, that old serpent, which is the devil." . . .

Sutu is a kind of Egyptian devil or dragon, eater of hearts, from whom the deceased prays to be delivered. In Chapter XVII of the Book of the Dead the deceased prays: "Deliver me from the great god who carrieth away the soul, who eateth hearts, etc. Who then is this? It is Suti." In Chapter XXVIII deceased again prays: "Let



THE LAKE OF FIRE.

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not my heart be given to him (Suti). In Chapter CVIII we read: "Then Sutu is made to flee with a chain upon him of steel." Sutu is sometimes found fused with the great serpent Apap, and he is represented on the sarcophagus of Seti I chained, with the scorpion goddess Serq lying over the chain. The exact meaning of the goddess in this position is unknown, as so much else in Egyptian mythology.

(13) The Lake of Fire.

Rev. xx. 14. "And death and hell were cast into the

lake of fire. . . . And whosoever was not found written in the book of life was cast into the lake of fire."

The Egyptian lake of fire is pictured with four apes seated at its corners, and four signs of fire between them. I have not been able to discover its object. In Chapter CXXVI of the Book of the Dead we find the deceased praying, "Hail ye four apes. . . . do away with my evil deeds and put away my sin. . . . Oh grant that I may make my way through the underworld, and let me enter into Restau, let me pass through the hidden pylons of Amenti."

The four apes answer, "Come then, for we have done away with thy wickedness, and we have put away thy sin. . . . Enter therefore into Restau, and pass through the hidden pylons of Amenti."

(14) *The Wall of Jasper.*

Rev. xxi. 10. "That great city, the holy Jerusalem"; and 18th verse, "And the building of the wall of it was of jasper."

The fields of Aarru, to which the ancient Egyptian thought that the beatified deceased person went after death, had a wall of *iron* round them. Iron was used as a precious metal, being scarce and difficult to work, long before becoming a useful metal. The wall round the Egyptian Elysian Fields was not for strength, but it was made of the then most precious material known, showing the extreme antiquity of the remote time when this mythology arose. In Chapter CIX of the Book of the Dead, the deceased says: "I know the Sekhet Aarru of Ra, the walls of which are of iron." Again, in the papyrus of Nu, Chapter CXIX, deceased says: "Hail, ye Sekhet Aarru, the walls of which are of iron!"

Iron, on account of being magnetic, a mysterious property to the ancients, was also sacred and amuletic in Egypt.

In spite of having made these few achæological re-

marks, addressed to the intellect, I am thoroughly convinced of the truth of Paracelsus, when he says that "We must read the Bible more with our heart than with our brain," because the heart is greater than the mere brain

"For knowledge is the swallow on the lake
That sees and stirs the surface shadow there
But never yet hath dipt into the Abyss,"

but

"Who speaks the things that Love him shows
Shall say things deeper than he knows."

ALICE GRENFELL.

OXFORD, ENGLAND.

THE PERIOD OF THE EXODUS.

OUR knowledge of the Exodus is mainly derived from the Bible and from Manetho as quoted by Josephus.

It is not necessary to recapitulate the account contained in the Book of Exodus, of the plagues, the variability of Pharaoh, the flight, the pursuit, and the catastrophe. It is imprinted on the mind of the reader from childhood.

The narrative of Manetho is less familiar. It is in brief as follows:

An Egyptian king, Amenophis, desired to behold the gods, and, in accordance with priestly advice, purified his kingdom by separating all the lepers and unclean persons from the rest of the people, and assigning for their residence the old city of Avaris, once the stronghold of the Shepherd Kings. These unfortunates selected as their ruler a priest of Heliopolis named Osarsiph, who enacted a set of rules forbidding worship of the Egyptian gods; and caused them to fortify their city and prepare for war with the king. He further invoked the aid of the expelled race who had occupied Jerusalem,—and who came to his assistance with an army of two hundred thousand men. Amenophis did not venture to engage his allied enemies, but retired with his army to Ethiopia, where with a multitude of fugitives, he remained thirteen years. Osarsiph, whose name had been changed to Moses, ravaged Egypt during all these years; burning cities and villages and de-

burning the images of the gods, eating the sacred animals and smothering the priests. At the end of the thirteen years the monarchs retired from his excision—Amenophis retired with a great force, and Ramses his son with his wives, and encountered the foreigners and unclean men, gathered them, new multitudes of them, and put them in the armies of Syria.

While the discrepancies of these accounts are quite obvious and are usually emphasized by Josephus, some fundamental facts are common. There was an oppressed and persecuted by the Egyptians with aversion as impure and malignant settled apart in northeastern Egypt. During the latter part of their stay, great evils and troubles befell the nation and government. They were pursued from the country.

It was for some time supposed that contemporary Egyptian records threw no new light on these important and obscure events. I will endeavor to show that this is not the case, and that other sources of information enable us to contemplate the period of the Exodus somewhat more clearly with its general activity and wide spreading innovations.

The latter part of the great Saïier Papyrus contains a concise account of the events recorded by Manetho. King Ramses III in an address to his soldiers says:

The land of Egypt had fallen into a state of ruin, and every man did that which it seemed right for him to do, and for very many years the people had no chief governor who was able to maintain dominion over the others. The land of Egypt was in the hands of governors of the nomes, and among the nobles and lords of the land one killed the other. There came a period after that of years of want and great misery, and Arsu the Syrian made himself prince over them. He placed the whole country under tribute to him, and each man gathered whatsoever he could for himself, and plundered the property of others, and they treated the gods in this manner likewise as well as men, and the sacrifices which ought to have been

made to the gods in the temples according to law were never offered up at all. Then the gods overthrew those men and brought peace into the country, and they made the country to be what it ought to be, and fashioned it according to what was right. And they established their son who had proceeded from their members to be the prince of every land which was under their throne. Rausrkhausete~~pen~~rameramen, son of the sun Setnekht-nerer-Ramerer-Amen. And he became like Khepera Set when he burneth with wrath and rageth, and he provided with all things the land which was in a condition of revolt and misery. He slew all those who were disloyal in the land of the inundation, and he purified the great throne of Egypt. He became the sovereign prince of two lands upon the throne of the god Tem. He gave himself to a reconstruction of the things which had fallen into a state of decay, and at length every man regarded as his brethren those who had been divided from him as by a wall. He established the temples and provided them with divine offerings, and men made the offerings which they ought to make unto the company of the gods according to their ordinances.

"He raised me up as heir to the throne on the seat of the earth-god Seb, to be the great governor of the Egyptian dominions in care of the whole people who have found themselves united again.

"And he went to his rest out of his orbit of light like the company of the celestials. The rites of Osiris were accomplished for him. He was borne in his royal boat over the river, and was laid in his everlasting house on the west side of Thebes.

"And my father Amon the lord of the gods, and Ra and Ptah with the beautiful face caused me to be crowned as lord of the land on the throne of my parent."¹

That this speech of Ramses III and Manetho's account describe the same events is quite evident. The confusion and desolation of Northern Egypt, the cessation of temple worship, and temporary predominance of Osarsiph, or Arisu, the restoration of order by Setnekht, followed by his admission of his son Ramses to important public stations, are in strict accordance with Manetho.

Ramses III to whom the above address is ascribed, was one of the most famous of the Egyptian kings. He

¹ *Vide* Budge, *Hist. of Egypt*, Vol. V, 145; and Brugsch, *Hist. of Egypt*, Vol. II, 143. In the latter part I follow Brugsch as less technical.

well deserved the promotion awarded him in his youth, mentioned both by him and Manetho. His reign revived the glories of Thotmes III and Ramses II. He repelled the Lybians and northern invaders, and successfully invaded Palestine and northern Syria. The inscription on the east face of the great pylon of Medinet-Habu shows the numerous cities reduced under his control, and gives minute though not now thoroughly comprehended information respecting the geography of Palestine before the occupation of the Israelites. The above quoted Sallier Papyrus shows him, in its other parts, as a devout worshiper of the gods, and contains inventories of his rich and varied offerings. Such profusion of wealth, gathered from the spoils of foreign countries and the revenues of a well-ordered state, gained him the reputation of being the wealthiest of all kings. As such Herodotus mentions him, calling him the wealthy and miserly king Rhampsinitus. Brugsch shows that at home he bore the title *Ramessu pa nuter* (Ramses the God), from which the Greeks derived the name found in Herodotus and Diodorus.

His father Setnekht thus appears as the Pharaoh of the time of Moses. But the name Setnekht is not that given by Manetho, who calls the father of Ramses by the name of Amenophis. How does this discrepancy occur? Neither Ramses III nor any other Ramses was the son or immediate successor of an Amenophis. If we compare the succession of sovereigns of that period as stated by Manetho, with the monuments, we find some confusion. The monuments show the following list of kings of the XIXth Dynasty:

Ramses I.
 Seti I.
 Ramses II. (Reigned 66 years.)
 Merneptah I.

Seti II.

Amunmesu.

Sipthah.

The XXth Dynasty begins:

Setnekht.

Ramses III.

Ramses IV, and so on with kings named Ramses to the end of the dynasty with XIII.

Manetho's list of the XIXth Dynasty is:

Sethos.

Ramses (Reigned for 66 years.)

Amenepthes. (Reigned for 20 years.)

Ramses. (Reigned for 60 years.)

Amenemes. (Reigned for 5 years.)

Thuoris or Polybos. (Reigned for 7 years.)

He begins his list of the XXth Dynasty with Nekepsis, and it only contains one king named Ramses.

* instead of thirteen, and names a series of other kings not found on the monuments.

Manetho is substantially correct in his statement of the length of the reign of Ramses II. It was sixty-seven years. He may be correct in that of Amenepthes or Merneptah, his son, though the highest monumental number of the latter is eight. He follows Merneptah with another Ramses reigning sixty years—evidently a repetition. So treating it, we find the successor of Merneptah, according to Manetho, to be Amenemes. This king was probably the Amunmesu of the monuments, but as he appears in Manetho as the immediate predecessor of Thuoris (whom we shall find to be Ramses III), it is most probable that he is the person whom Manetho calls Amenophis. Manetho in one place calls him Amenophis and in another, Amenemes, thus presenting them both as the father of Ramses III. We can only rely on Manetho when he can be reconciled with the Sallier Papyrus. That document represents Setnekht as the father of Ramses III, and

shows that they cooperated in restoring peace after the disorders occasioned by Arisu.

The name Osarsiph is given by Manetho. Birch and Eisenlohr read it Aarsu. Brugsch makes it Arisu, or Alisu, or Alius. Budge reads it Arsu. It may be read Osarsiph. The best reading now practicable is Iarsu. The papyrus calls him a Khar or Khal. This term translated by Brugsch, Phœnician, was applied not merely to that people, but also to the Semitic population extending from Tanis to Aupa in northern Syria.² Manetho says that Osarsiph was a priest in the temple of Osiris at On. This does not necessarily imply that he was a member of the sacerdotal class. There were lay priests in the Egyptian temples, who alternated in the care of accounts and revenues.³ They had good opportunities of learning whatever was taught. Of such a scholar it might well come to be said that he knew all the wisdom of the Egyptians.

On (Heliopolis) was a seat of learning to which, after centuries, Greek students repaired. There Pythagoras studied under his master Oinuphis. There Amenophis IV had founded, within a century before Moses, a temple to Aten the god of a peculiar monotheistic worship, hostile to that of the Egyptian gods.⁴ Osarsiph could not have been ignorant of this religion, and he exhibited even a fiercer hatred of the gods of Egypt than was shown by the heretic king. The same spirit was shown by Moses when Aaron set up an image of the Egyptian god Mnevis.⁵

Some confusion has arisen from the fact that Manetho represents Amenophis (Amen hotep) as consulting

² Brugsch, *Hist. of Egypt*, Vol. I, 256.

³ *Zeitschrift für Aegyptische Sprache*, XL, 113.

⁴ *Idem*, 112.

⁵ The relations between Hebrew monotheism and that of Amenophis I have excited much discussion, but are imperfectly understood. Both were exclusive. Breasted in *Zeitschrift für Aegyptische Sprache*, XL, 106.

prophet of his own name, the son of Papi. Amenophis III really had a renowned chancellor, Amenophis the son of Hapi. The impossibility of regarding the Exodus as occurring in the reign of Amenophis III or his successor Amenophis IV has led some Egyptologists to deny that the account of Manetho has any reference to the Hebrew Exodus. To suppose, as Edward Meyer does, that the Egyptian historian had in mind only the religious schism of Amenophis IV is to discredit both Manetho and the Exodus account, and relegate the whole subject to the realm of unintelligible myth. As well take the position of Dr. Inman, who maintains with great earnestness that the Jews never were in Egypt.

The confusion seems to have its origin in the fact that there was at Memphis a temple of Amhotep, the god of prophecy, whom of all others Setnekht, a Memphite man desirous of knowing the future, would be most likely to consult.

When did the Exodus occur? Evidently during the latter portion of the reign of Setnekht; that is to say, a short time before that of Ramses III began. Dr. Mahler, the principal authority on Egyptian chronology, fixes the year 1240 B. C., as the first year of Ramses III.⁶ Bunsen has shown that Hebrew chronology throws only a feeble light on the question.⁷ The irreconcilable statements of the received text, the Septuagint, and Josephus, and the doubt which of the Judges are synchronous, throw the matter into confusion. One gleam of light is visible. There were between Aaron, who was the high priest at the time of the Exodus, and Zadoc, who anointed Solomon B. C. 1010, eleven high priests succeeding each other

⁶ *Zeitschrift für Aegyptische Sprache*, XXXII, 102. Mahler's conclusions are regarded as substantially correct for dates not earlier than the XVIIth dynasty.

⁷ *Aegypten's Stelle in der Weltgeschichte*, I, 218. The subject is exhaustively treated in IV, 320.

by the law of primogeniture. Taking twenty-two years, the average length of the reigns of hereditary monarchs, as a criterion, their administrations would fill a period of two hundred and forty-two years, or only ten years more than the interval between B. C. 1010, and 1242. This estimate, however unreliable as to the exact numbers, is sufficiently near the truth to discredit the period of four hundred years of the received text, (440 of the Septuagint) given as intervening between the Exodus and the building of the temple, and to indicate approximately the correctness of the date above given.

Ramses II is recognized by most Egyptologists as the Pharaoh of the persecution. He it was who built, or at least greatly enlarged the cities of Rameses and Pithon, and imposed severe labor on the Israelites. Impressive as anything in the Book of Exodus, is a sentence in the dialogue between him and Ptah in respect to the great temple to that god which he built in Memphis. The king says "I brand with a hot iron the foreign peoples of the whole earth. They are thine forevermore." This king ascended the throne B. C. 1347, at the age of 20 years and reigned 67 years, or until 1280. The above inscription is of the 35th year of his reign, and commemorates the completion of the temple. He had a large family of children by wives and concubines. Among the daughters was a younger one,—the Princess Meri. It cannot be far out of the way to assume that she was a grown up girl at about the date of the above inscription. Eusebius says it was she who found the infant Moses. The birth of the foundling was probably not far from this date, or B. C. 1312. At the accession of Merneptah in 1280, he would thus have been thirty-two years old. At the period of the Exodus, 1242, he would have been seventy. The Exodus account says he was eighty.

* Brugsch, *Hist. of Egypt*, II, 90.

Merneptah succeeded Ramses II. His oldest monumental year is the eighth. The principal event of the first part of his reign was a great invasion from the west, occurring in his fifth year and triumphantly repelled. There is preserved an official account of this invasion, and also a hymn of triumph. The latter mainly celebrates the victory over the Lybians, but contains a verse that is sometimes cited as proof that the Israelites were in Palestine at the time. As translated by Spiegelberg it reads:⁹ "Wasted is Thnw: Cheta quieted: Canaan with all the vile seized: Gezer captured: Jenom brought to naught: Israel devastated and its crops destroyed: Hor has become like the widows of Egypt. All lands are at peace." The countries named are Lybia; Cheta (the country of the Hittites); Canaan, the lowlands of the coast and of the Jordan Valley; and Hor, southern Palestine. Beside these, four cities are named: Askalon, Gezer, Janom and Israel. The first two are well recognized. "Janom" is probably the Janina of Josephus, the *Jabne-el*¹⁰ of the Hebrew text, and "Israel" is *Jezre'el*,¹¹ lying to the north of the others. The hymn may contain an allusion to their names, for it appears that the first which claims to have been built by God is brought to nothing, and the harvest which God has sown is devastated.¹² The language of Palestine was not unfamiliar to educated Egyptians, as the Tel el Amarna tablets show. The hymn probably commemorates incidentally some expedition which brought those four cities into subjection,—an exploit magnified into an establishment of authority throughout Syria. There is nothing to show that the Hebrews were in Palestine in

⁹ *Zeitschrift für Aegyptische Sprache*, XXXIV, 14.

¹⁰ יבְנֵי־אֵל

¹¹ יִזְרְעֵאל

¹² *Jabne'el*, "God has built." *Jezre'el*, "God has sown." A similar word play is found in the next sentence, "*Khar* (Syria) has become like the *khart* (widows) of Egypt."

Merneptah's time. If there in the fifth year of his reign after forty years of wandering, they must have left Egypt at latest, when Moses was a child, and in the midst of the prosperity of Ramses II.

Merneptah was succeeded by his son Seti II, whose highest monumental year is the second. As to what happened in Egypt after the death of Seti II we know little from any other source than the Sallier Papyrus. Siptah a son of Seti II, with his queen Tauser appears, and another king, Amennesu, followed by Setnekht. It is supposed that the two former were rival claimants of the throne, whose conflict was the beginning of anarchy. The Sallier Papyrus shows that there were three periods:

1. A considerable period of anarchy such as would naturally occur during a disputed succession, different nomarchs engaging in feuds at will, without restraint from any central power.

2. A period of scarcity during which Arisu raised himself to power and spoiled the Egyptians, and insulted their gods. In the Exodus account, this period of scarcity is treated as one of various miraculous plagues.

3. The establishment of the authority of Setnekht, who punished the guilty and brought in prosperity.

Arisu, who was the ruling spirit during the later anarchy, had, according to Manetho, attained priestly accomplishments, and according to the biblical account, became versed in the wisdom of the Egyptians. According to Josephus, he had also a large military experience, having been commander in a war against Kush, or Nubia. Brugsch discovers a certain Mas who was viceroy of Kush in the latter part of the reign of Ramses II, and in that of Merneptah. The Exodus account represents him as escaping by flight the penalty of homicide, while Josephus adds a court cabal against his life. After a lengthened absence, the general disorder rendered his return safe

Times of turmoil bring oppressed classes to the front, and men of capacity and energy assume their leadership. This man of tremendous capacity and energy became a leader, and conducted his people out of Egypt. Their departure was at last a precipitate retreat. Smoke signals by day and fire signals by night furnished information to the pursued of the motions of their pursuers. A beach bared by a strong wind afforded a passage, and the reflux waves checked pursuit with serious loss to those who followed carelessly. The pursued rejoiced that Jehovah had saved his chosen people from destruction; the pursuers, that their gods had freed their country of a dangerous element, though prohibiting pursuit beyond the frontier.

Ramses III entered on a long and prosperous reign of thirty-two years. He made several campaigns in Palestine and Syria, and fully restored the authority of Egypt. In these campaigns he found no Jews in Palestine. His march was not confined to the coast country. Hebron, Jerusalem and the cities of Moab were brought beneath his power, as well as the cities of the coast. He is said by Maspero to have introduced the Philistines to the region thereafter occupied by them. If his garrisons had occupied southern Palestine when it was reconnoitered by the Hebrews, their dismay and retreat are readily explainable. At any rate, no entrance into the west Jordan land could be attempted during his life, or probably during the six years reign of his son Ramses IV.

Under Ramses V, anarchy broke out again in Egypt. There was a conflict between ecclesiastical authority, vigorously maintained by the high priests of Amon, and civil authority, feebly maintained by short-lived kings; between Upper and Lower Egypt, which differed slightly in people and dialect; perhaps an economic reaction against the heavy taxation and profuse expenditure of the reign of Ramses III, like that in Judea under Rehoboam. It was

a fatal blow to the prestige of Egypt. The forty years of power of the Egyptian kings after the departure of the Hebrews toward the close of Setnekht's reign, and the anarchy which succeeded these forty years, explain why the Hebrews were forty years on their migration. When that forty years closed, Egypt became, as to foreign influence, a mere cypher, and so remained for about two centuries. Joshua met with no opposition from the Egyptians. The impotence of the ruling country had given independence to every city and district. There is no evidence that the Jewish conqueror thought of the Egyptians while subduing the thirty-one kinglets who severally in small combinations opposed him; no evidence that a considerable body of Egyptian troops passed out beyond the ramparts of Migdol before the time of Solomon.

Manetho represents the Jews as a collection of diseased and leprous population of Egypt,—a view absurd in itself, since such a community would soon have become extinct,—and greatly resented by Josephus; but probably having a foundation in the religious ideas of the Egyptians. Inscriptions of Merneptah and Ramses II show that in counting their slain enemies, the circumcised and uncircumcised were separately enumerated. All uncircumcised persons were impure. It is probable that great numbers of those who left Egypt with Moses were uncircumcised, and therefore impure. The growth of national hatred in later times exaggerated this technical impurity to the frightful extent appearing in Manetho's narrative. It is true that this view of the non-circumcision of the departing Jews is expressly contradicted by the received Hebrew text, which says: "Now all the people that came out were circumcised, but all the people that were born in the wilderness by the way as they came forth out of Egypt, them had they not circumcised." (Joshua v. 5.) But the Septuagint gives an entirely different account.

It says that Joshua circumcised whosoever were born on the way, and whosoever of those that had gone out of Egypt, were uncircumcised. And again: "For most of the fighting men who went out of Egypt, were uncircumcised."¹³ The text which the Greek translators had before them is likely to be more correct than our received version. The great medley¹⁴ that went up also with them, (Ex. xii. 37) were probably other foreigners reduced to servitude in the Delta. If this view is correct it is readily seen how the Egyptians would brand as impure a community containing a large percentage of uncircumcised persons; and not practising the rite for forty years. Its renewal by Joshua at Gilgal "rolled off the reproach of Egypt" from his people.

Classic authors confirm the Hebrew and Egyptian accounts, and afford an invaluable synchronism. Pliny speaks of "Rhameses quo regnante Ilium captum est." To which of the numerous kings named Ramses does he refer? A reference to Herodotus answers the question.¹⁵ That historian relates that Paris came to Egypt with Helen just before the Trojan War, and found there a king whose name in the Greek language was Proteus. He goes on to relate that Rhampsinitus was the son of Proteus. As Rhampsinitus is certainly identified with Ramses III, Proteus is thus identified with Setnekht. That which is a necessary inference from the language of He-

¹³ The Hebrew text is:

כִּי מֵלִים הָיוּ כָּל הָעָם הַיִּשְׂרָאֵלִי וְכָל הָעָם הַיִּגְרִי בְּיָדָם מִמִּצְרָיִם לֹא
מְצֻרִים

But the Septuagint says:

Ὅσοι ποτὲ ἐγένοντο ἐν τῇ ὁδῷ καὶ ὅσοι ποτὲ ἀπερίτμητοι ἦσαν τῶν ἐληλυθόντων ἐξ Αἰγύπτου πάντας τούτους περιέτεμεν Ἰησοῦς.

and again:

διὸ ἀπερίτμητοι ἦσαν οἱ πλείστοι αὐτῶν τῶν μαχίμων τῶν ἐληλυθόντων ἐκ γῆς Αἰγύπτου.

The translators had no such text before them as that of our received version.

¹⁴ עֲרֵבֶרֶךְ ἐπιμίκτης πολὺς.

¹⁵ Herod. II, 112.

Herodotus, appears clearly stated by Diodorus, who says (Diod. Sic. I, 62):

"After this king (Mendes), anarchy occurred for five generations. One of the obscure men was chosen king whom the Egyptians call Ketena, but among the Greeks he seems to be Proteus, who lived during the Trojan War. What the priests say of him agrees with what is handed down concerning Proteus' acquaintance with spirits and changes of form; for they say that from association with astrologists, which he held continually, the king had acquaintance with such matters; and that the Greek fable concerning change of form was derived from a usage handed down among Egyptian kings, that the rulers of Egypt should wear on their heads, faces of lions, bulls and dragons, emblems of authority: and sometimes trees, and anon fire, and sometimes many agreeable spices; and thus they array themselves for ornament or for inspiring astonishment and superstitious feeling. After the death of Proteus, Rempsis his son, inheriting the kingdom, spent his whole life in attending to his revenues and amassing wealth from every source."

Lepsius identifies Ketena with Setnekht, and there can be no mistake in this. But why did the Greeks call him Proteus? The noun Proteus,¹⁶ like most nouns terminating in *eus*,¹⁷ denotes a member of a class. It is derived from *protos*,¹⁸ and points to a class of which each member is a first man. To only one Egyptian king, Menes, could the word *protos* be applied, but every first king of a dynasty was a *Proteus*, and Setnekht was the first king of the twentieth dynasty. Herodotus and Diodorus speak of him as a parvenue, and he seems from a careful examination of his tomb, to have appropriated that of King Siphthah and his queen Tauser to his own use, which would not have happened had he been in the line of legitimate succession.

The Odyssey represents Menelaos as visiting Egypt after the capture of Troy, and mentions among his wealth articles of value given him by Polybus and his wife Alcandra at their house in Thebes. It is not expressly stated

¹⁶ Πρωτεύς.

¹⁷ As ἄλιεύς, ἱερεὺς, βραβεύς, ἱππεύς.

¹⁸ Πρωτεύς.

that Polybus was king of Egypt, but as he entertained a king and gave kingly gifts, the presumption arose that he was himself a king. Syncellus speaks of him as "Thuoris, called Polybus by Homer, in whose time Ilium was taken." These names are not Egyptian but Greek, and point to Ramses III. The word *Polybos*, as Eustathius explains, means wealthy. Thuoris¹⁹ is in some manuscripts *thures*²⁰ and seems to be a slightly varied form of *thyoros*²¹ a sacrificant, or preparer of sacrifices. These epithets fit the wealthiest of kings, whose unprecedentedly great sacrifices to Amun are enumerated in the Sallier Papyrus, and surpass those of all other kings ancient or modern.

Setnekht was on the throne immediately before the Trojan War, and Ramses III when Troy was captured. The capture then occurred early in the reign of the latter king. If Mahler's computation of the reign of Ramses III is correct, the city fell between B. C. 1240 and 1235. That it was near the former date is probable. Herodotus, writing about B. C. 443, says that the capture of Troy occurred eight hundred years before his time. A scintilla of evidence in the same direction is found in the Odyssey.²² Odysseus tells Eumaeus of his feigned adventures as follows: He returned to Crete with Idomeneus at the close of the Trojan War, and there fitted out a predatory expedition to Egypt. Recruits flocked to him and filled his ships at once. What more plausible, when there were so many disbanded veterans of the war? The invaders landed on the Egyptian main, and were in the full tide of plunder, devastation and enslavement of captives, when the king of Egypt arrived. The disguised hero describes the terrors of the Egyptian array, the rout and slaughter of the marauders, and how he crept to the king's knees and obtained mercy. Though it was but a feigned tale, it could only obtain credence by connection with some known fact.

¹⁹ θουώρις.²⁰ θούρης.²¹ θυώρος.²² XIV, 305.

Now in fact there occurred in the fifth year of Ramses III. an invasion of Egypt by the Lybians assisted by northern peoples. That Greeks participated in the invasion is proven by the representation at Medinet Abou, of Ramses III smiting the Danana (the *Danaoi*²³ of Homer) with his battle-axe. Among others of his opponents are mentioned the Leku or Lycians, whose connection with Crete is well known,²⁴ with others whose identification is less reliable. The naval power and piratical habits of the Cretans make it extremely probable that they engaged in expeditions against Egypt of the kind described by Homer, and that the idea of such an expedition occurring soon after the Trojan War, was familiar to men who lived in Homeric times.

The above synchronisms enable us to form an estimate of the period of the Exodus. Egypt was at the height of military, financial and literary splendor, but verging on decline. The scattered communities of Hellas had come to a consciousness of collective power, and united in a great undertaking. Though the thalattocracy of Minos had gone by, Cretan corsairs waylaid the paths of Phœnician commerce and ravaged the Egyptian coast. The Hebrews entered upon conflicts beyond the Jordan, and from a rude horde of emigrants, became a nation. It was a period of organization, of energy and of activity,—one of those periods that shine out in history, and are followed by times of dullness and obscurity. Such a period appears in Egyptian, Greek and Hebrew history. The time of the later Ramessids in Egypt, of the Judges in Palestine, of the age succeeding the Trojan War in Greece, remind one of the Merovingian and later Carlovingian eras in France.

In such active periods not only does history flourish, but myths arise. How fruitful the Trojan War has been of the latter need hardly be alluded to, but this discussion

²³ *Danaoi*.

²⁴ Hoeck, *Kreta*, II, 337.

cannot be closed without reference to the Greek myths about the Egyptian king Proteus. As early as the time of Homer, the mythical character of the old man of the sea was attached to him.²⁵ He came with the flock of Poseidon from the watery depths, to take his daily repose on the isle of Pharos, off the Egyptian coast. Menelaos under the direction of Eidotheia, seizes him, and notwithstanding his struggles and changes of form into a lion, a dragon, etc., holds him and compels him to prophesy. Historical features show dimly through this atmosphere of fable. Here is a reminiscence of the changeful Pharaoh of Exodus,—the Amenophis of Manetho,—timid, superstitious and addicted to vaticination. But the feature of submersion in the sea is most prominent. It does not appear either in the Hebrew or Egyptian accounts, that the king perished in the sea, nor does Proteus seem to have been the worse for frequent submersion.

The myth related by Tzetzes presents us with Proteus as an Egyptian king, son of Poseidon, who went to Thrace and there married Torone. His sons by this marriage were undutiful, and he prayed to his father Poseidon to carry him back to Egypt. The great god of ocean led him back to Egypt by a miraculous tunnel beneath the sea. Here again is Setnekht, absent, returning; submerged, triumphant. His mythical family are instructive. As in the Odyssey, he had a daughter Eidothea,—one who sees God,—so in the other myth, he had a daughter Theonoe,—one who knows God. The aspiration of Manetho's king was to see the gods. He had an elder son Tmolus, slain by Hercules, and also a younger son Teligonus,—later born. The first born son of the Pharaoh of Exodus died, and the epithet Teligonus would fit Ramses III. The name of another son Polygonus seems an epithet appro-

²⁵ Odyssey IV, 365. The myth of Proteus is much like that of Nereus.

priate to Ramses III. He was *Polygonos*,^{**} prolific—a appears from his eighteen sons, several of whom reigned and his fourteen daughters. Another son was Theoclymenus—renowned god,—which seems an attempt to translate his title of Ramses-pa-neter. We can see in these myths, as in history, the features of the superstitious, timid and vacillating king, and his illustrious son, with a prominent idea of submersion without harm in the sea.

The vault of Deir el Bahri has given up the body of Ramses III. Lauret has found that of Setnekht, and the faded lineaments of him whom Moses saw in the field of Zoan, meet the eyes of the men of the twentieth century; but Moses was buried obscurely, and “no man knoweth of his sepulchre until this day.”

GEO. W. SHAW.

GENESE0, ILL.

^{**} Πολυγόνος.

THE SOUL IN SCIENCE AND RELIGION.

AMONG all questions, theoretical as well as practical,—philosophical, scientific, ethical, and those of everyday life,—the problem as to the nature of the soul stands foremost in importance. For it is obvious that whatever we do, the conception of ourselves will always be the ultimate principle from which all other questions will have to be viewed and it is noteworthy that a great part of mankind exhibits on this very topic a peculiar anxiety as if the fate of their welfare depended on the decision of some general theory.

The nervous excitement which is prevalent in many circles can be traced with special clearness in the transactions of the Society for Psychical Research, the work of which is vigorously carried on, on both sides of the Atlantic, in England and the United States. The aim of the Society is most praiseworthy, and the result will be good in so far as it will contribute its share to clear up the situation. The leaders are both earnest and honest, and yet it is to be feared that the evidences in favor of post mortem communications and kindred occult phenomena will prove disappointing. The main result will be negative. Negative results, however, may be just as important and beneficial as affirmations, for they cut off useless speculations, and by limiting the field of investigation, help to make our positive theories more definite. Therefore even if the result will finally and definitely be found to be purely

negative, the labors of the society could by no means be looked upon as useless or redundant, and so we feel grateful for the work accomplished, although our attitude is necessarily critical.

The main fault in the methods employed by the Society for Psychical Research appears to be that most of its members show a tendency to seek for the solution of the soul problem in abnormal phenomena which offer at best merely distorted pictures of normal conditions. But there is an excuse for their procedure. We are so accustomed to normal conditions that we appreciate the psychical significance of our soul life more forcibly when we observe variations of certain familiar features in the abnormal shape of some grotesque pathological phenomenon. Yet there is this danger, that if the main fact is veiled by complications it leaves a greater play to our imagination and so pleases mystical and fantastical minds. But upon the whole it may be claimed that abnormal facts of soul life so far as they are truly facts, reveal nothing more wonderful as to the nature of the soul than what is contained in normal soul life.

Among the different schools there has always been a rivalry between materialists, so-called, and spiritualists; the former claiming that the soul is a mere function of matter and accordingly without permanent significance, while the latter regard spirit as real, and for this reason would insist upon the reality and permanence of soul life. There is no need here of entering into a philosophical discussion of the subject and we would only point out that the issue has been greatly confused by lack of precision in the use of terms. The point which the so-called materialists insist upon is true enough in the sense in which they mean it. Nothing is real in the sense of "actual" or "thingish" except that which is corporeal. This statement, however, is simply a tautology, for real is derived from *res*,

"thing"; as actual is that which can act and is endowed with energy. But if we mean by real that which is efficient, in other words that which enters as a factor in the chain of causation, we will understand that the relational or the purely formal, which is non-material, is even more important in the real world of things than either matter or energy. The direction of a movement is the main thing on which the result in a special case depends. It is of the greatest consequence whether or not a rifleman takes the proper aim, while it is comparatively insignificant from what source (dynamite, powder, or compressed air, etc.) he derives his propelling force, or what may be the material of his projectile. The Greek accordingly called the immaterial element, "cause-like" or "causative,"¹ commonly translated "formal."

For this reason both materialism and spiritualism have never played any significant part in the history of philosophy and science except in circles of dilettantish thinkers who formulated their materialistic doctrines in contradiction to some mistaken views as to the nature of spirit. Materialists propose to explain everything from matter and energy or matter and motion and forget that matter and energy explain nothing, and being mere generalizations of a very abstract nature are quite unfit to explain anything. They are purely descriptive terms of certain universal qualities that all objects (things of objective reality) have in common. On the other hand spiritualists rightly correct materialism when they insist on the reality of spirit; but to be just we grant that there is a certain justification for the materialist's criticism of spiritualism in the materialistic conception of spirit which prevails among the spiritualists proper. A large class of people materialize spirit. Not unlike their adversaries, the materialists, they cannot imagine that any thing non-material

¹ τὸ αἰτιώδες.

is of actual efficiency, and so they change spirit into what is commonly called ghost. Spiritualists, so-called, have a wrong and crude notion of soul, conceiving it as a material entity, as if it were a bodily being made of some sublimated substance, air or ether or perhaps an unknown material. That they think of the soul substance as very ethereal is, theoretically, of very little importance, for remains nevertheless a substance, and so spiritualistic theories become practically a psychical materialism. Matter remains matter, be it ever so attenuated, for even ether a material substratum, and if the soul consisted of ether it would be just as surely corporeal as if it were made of denser substances such as bones and flesh.

As to man's anxiety to prove that the soul is spiritual and not material, we would say that the common facts of every-day life are sufficient evidence against materialism and among them that wonderful phenomenon, consciousness, stands forth in its undeniable pre-eminence. Consciousness is not composed of matter, nor is it energy. It belongs to another category; it is *sui generis*. Consciousness is an intense state of feeling, and feeling is neither matter nor motion. It does not belong at all to the realm of objective reality, it is subjective. All objects are things, and objectivity manifests itself as matter in motion. The existence of consciousness indicates that objective reality is merely the exterior of existence, and that there is an interior, the existence of which is an undeniable fact and not merely a problematical theory. Though the subjective and objective are contrasts, they are not necessarily different nor are they unrelated; they are closely interlinked and the simplest solution which explains all difficulties is to view both as phases or aspects of one and the same reality. They are two sides of one fact, and, though if we take our stand on one side the other always appears as purely

phenomenal, we have sufficient reason to insist on the reality of both.

But few words may suffice to explain what we mean by subjective and objective.

If we consider our experiences as they are in themselves we will be forced to admit that every one of them consists of feelings or sets of feelings. What we call "objective" is first given us as a system of sensations from which as an ideal inference we construct the material world, and so the most materialistic world-conception is ultimately a mere conclusion (or even an assumption) based upon sense-impressions. If we analyze our world as much as we may, we can never quit the circle of sentiments, sensations and ideas. Our entire being is built up with them and what we designate as actual is really an idea.

On the other hand we must grant that all the experiences of our mental life present different forms of sense-impressions, and these different forms are pictured as bodily existences surrounding us in space. Our space conception represents the distance to be traversed to reach the point under consideration, and the feasibility of these practices, well established by experience, justifies the general scheme of this method of viewing the world as things or bodily objects moving about in space. Our conception of matter corresponds with the sense element in our experiences. It means resistance felt, and thus it describes the most general feature of sensations. It is that which somehow touches (or is capable of touching) one of our organs of sense, that which opposes (or is objected to) the subject.

For all practical purposes we can eliminate the psychological condition which is presupposed when speaking of matter, and in the same way the geometer can make his measurements and calculations without minding the psychological facts upon which his space conception is built. Scientists may treat matter, motion and space as definitely

given data, and as long as they have phenomena of the objective world under consideration, that is, so long as they contemplate bodies in motion, they will encounter no difficulties either philosophical or psychological. They eliminate for their special purpose the psychological phase of existence; and so the objective world will appear to them as real, while feeling will be a mere spook, a ghost, a transient guest within their range of inquiry that may well be disregarded.

It is obvious that for philosophical purposes neither a purely objective representation nor a purely subjective description of life will be satisfactory. We need both and must harmonize both. Though for certain investigations either standpoint may be negligible, we must never forget its actuality. Under all circumstances one fact stands out most prominently, and that is the spirituality of the world. Consciousness cannot be an accidental phenomenon of life, but must be an integral feature of it. The prevalence of potential consciousness which we call subjectivity is an inalienable quality of existence, and therefore we are assured that consciousness does not make its appearance simply on account of a strange haphazard formation, but it must develop with necessity according to the intrinsic constitution of the universe.

It is even probable that the potentiality of consciousness implies a tendency towards realizing it. We speak figuratively of an affinity among chemical elements and grant it to be a mere figure of speech; yet the simile may be truer than philosophers imagine. It would be fantastic to look upon inorganic nature as endowed with feeling, and yet we must grant that there exists in it some subjective state analogous to the feeling of sentient creatures, and we may look upon it as a lack of equilibrium with the rest of the universe, implying the tendency of readjustment.

Let us assume that there is such a thing as undifferentiated existence, which we will call world-stuff or ether. If a differentiation set in, it might show itself in little whirls or centers of subjectivity. A differentiation is not an isolation and so the interaction with the surrounding universe continues. Experience teaches us that all atoms are animated by a universal attraction called gravity and also that different kinds of atoms (presumably according to the geometrical form of their inner conformation) possess the tendency to combine themselves in more and more complicated groups. The most wonderful combinations are those which are most unstable, possessing at the same time the property of renewing themselves. This round of changes which constitutes the most characteristic feature of life is called metabolism.

Life accordingly is a process due to the tendency of organization. It consists of the functions of building up, breaking down, and renewing. Elements combine into a higher union in which some energy is stored up,—a function called anabolism; thereupon the energy is set free in motion which causes a breakdown of part of the structure called katabolism. Both together constitute metabolism.

If we try to view the actual facts of life under *a priori* considerations we may well grant that isolated feelings would be mere states of irritations, they would not become conscious, for though they might feel, they would not be felt. In order to be felt, feelings must be organized into a system of interacting feelings, in which different feelings are contrasted, classified and intensified. This is exactly what takes place in the nervous system of animal organisms, and we may very well credit this final outcome to a certain hunger for organization, which is naturally present in all primitive existence as the main need of its subjectivity.

We are so accustomed to consciousness that its marvelous existence no longer strikes us, and so its significance is brought home to us more strongly in the abnormal phases that it assumes in pathological conditions. But after all consciousness is sufficiently evidenced in our common every-day experience, even though we are apt to overlook it because through sheer habit we have become callous to its existence. Let us but once become fully cognizant of what the existence of consciousness means and we shall no longer feel obliged to hunt for evidences of the spirituality of the world in pathological domains.

The same is true of sundry other facts. For instance, investigations have been made to prove an abnormal and miraculous kind of telepathy in order to exhibit the power of mind, and yet the daily fact of sensation which takes place in the experience of every one is properly speaking a phenomenon of telepathy. We do not mean telepathy in the absurd and disfigured sense of the word in which it is now used, that we can know or notice something without any means of communication, but in the literal sense of the word which means "perceiving at a distance" and in this sense every sensation is telepathic.

For instance, our eye receives a slight light-impression and thereby we perceive the existence of a star which is so far off that its light must travel many thousand miles before it reaches our earth. Our perception of the starry heavens is perhaps the most striking instance of the telepathy of our organ of sight, but our sensations of touch are not less telepathic, for the miracle is the same in either case. The object of touch is as much outside of us as the most distinct star and its presence is felt within the sentient subject, and strange to say the sentient subject conceives the existence of the perceived object to be outside. This inside perception of things outside, is telepathic in its very nature; and our entire world of thoughts, too, is repre-

sentative of objective existence, which means that it pictures things subjectively that possess (or are thought to possess) objective reality. They are felt in the mind and they exist in the surrounding world—yes, our mind is capable of extending its knowledge even to distant times. It can reconstruct the past, it can forecast the future, and so we are justified in characterizing the mind as a telepathic instrument.

When we consider the relative significance of form and matter, we will soon learn that matter is of little importance, while the form makes the thing what it is. From this point of view the ancient Greek philosophers looked upon the form of an object as the essential feature of the thing, and the material of which it was made as accidental. A statue, according to Aristotle, exists first of all as an idea in the artist's mind. Its existence as an idea (which means a picture, an outline, a mere form) is the beginning of its actualization. It is a potential existence, yet potential existence is not mere non-existence. When the artist chisels out the statue conceived in his mind the idea assumes actuality and the statue now manifests itself in material shape. Aristotle thinks of the thing as existing already in its potential state, and it is the idea that assumes materiality. In our days the average man would rather take the opposite view and speak of a block of marble as assuming the shape of a statue, as if the marble were the real thing and the statue an accidental quality of the marble.

It is obvious that the ancient conception is more correct. The essential feature of anything that exists is its form. The material is indispensable for actualization but it is after all of secondary consideration. If an artist has two blocks of Carrara marble of the same quality, one may be turned into a god and the other into a demon, and it makes no difference which block is used for either purpose. The character of the statue depends upon the form it re-

ceives from the sculptor's hand. A Raphael and a copyist may buy their material at the same shop and the difference is a mere accident which tubes of paint each may carry. The character, importance, and significance of their paintings does not depend on the material (canvas, paper, brushes) with which it is painted, but solely on the form in which the paint is fixed upon the canvas.

But the objection is made that there are different kinds of material. I may make a statue of gold, or silver, or marble, or of mere clay, and the value of the statue varies greatly accordingly. But this objection proves the significance of form, for what else is the difference between the different materials? If our present scientific world-conception be true, we must take for granted that practically all our chemical elements ultimately consist of the same stuff, particles of which are grouped in different configurations with varying density and molecular structure in the different elements. So the difference between the chemical elements is after all one of form, not of material.

It is true enough that without matter or energy, ideas would remain mere potentialities. In order to be actualized they must assume material shape and in order to be effective they must somehow be possessed of energy. But there is no actualization in the objective world without matter, motion, space and time. But the paramount importance of any thing after all is its causative or purely functional element. And this holds good with special force in the case of the main of spirit.

A thought which I think, is a state of feeling of a definite form, expressed in the domain of matter and not as a cerebral commotion that causes the tongue to utter a series of words. The burden of these words is the meaning of the sentence. Now we distinguish between the form or contents of the thought and the state in which it is

alized. The former is the idea, the latter a cerebral motion accompanied by consciousness.

The distinction between the state of thinking and the idea that constitutes the content of a thought, is rather subtle, and we cannot expect that the untrained multitudes will trouble themselves about these philosophical niceties. Nevertheless the distinction holds good and should not be neglected, for it implies more than we would expect. If we weigh the two we will see at once that the idea is more important than the state of thinking, for the thought as an act is transient while ideas are eternal.

All our thinking is truly a mere manifestation of the eternal potentialities of thought, just as man's rationality is an incarnation of the eternal principles of reason, or, as the author of the Fourth Gospel would say, of the *logos*. To us it is of paramount importance that we think the right thought at the right time. Hence we are naturally interested in the materialization of a good thought in our own brain. But after all the validity of the thought,—its thinkableness, its eternal possibility which constitutes its truth, its intrinsic validity and applicability, should be rated higher as being the presupposition upon which the worth of our own thinking depends.

Now we must bear in mind that man is a being of sense (and sense always is closely related to matter) and so it is not surprising to find that he is commonly materialistic. Being firmly convinced of the significance of the purely formal features of existence, man looks upon them as realities and represents them in his imagination as if they were concrete material entities. Thus the totality of causative factors viewed as the great formative principle of the universe is materialized into a concrete being, and assumes the figure of the highest individual that man is capable of imagining, which so far has been either the patriarch of the tribe or the monarch of a nation. Thus God, instead

of being considered as God, (i. e., a universal omnipresence whose existence is eternity and whose nature is infinitude), is conceived as an aggrandized human personality and is spoken of as "the Lord." The everlastingness of thought as truth is represented among all nations as a place. It is called the happy hunting-ground, elysium, aahlu, isles of the blest, heaven, paradise, nirvana, and represents in more or less materialistic imagery the eternal back-ground of our thought in which our very personalities will finally find their everlasting abode.

To the unsophisticated man these ideal conditions, or states of being, are purely phenomenal because he views them from the sphere of materiality in which his own life is so deeply rooted. He will declare them to be nonentities, or dreams, or mere bubbles of religious or perhaps philosophical imagination. Yet their result asserts itself in practical life and there are not a few among all the races of mankind who feel the power of things spiritual, and according to their intellectual capabilities they clothe them with the garb of poetic visions. This is the origin of religion and all that is connected with it. It gives rise to superstition, but if we beware of the fallacy of taking the poetic imagery of religious imagination in its literal meaning, we shall unhesitatingly grant that the religious emotions are perfectly justified upon philosophical grounds.

Religion is an instructive method of supplying mankind with truths which are beyond the reach of the multitudes, and the truth of any religion should not be judged by its literal dogmas but by their significance and ultimate purpose.

As to the soul, the different religions have produced different conceptions, and we shall find that almost every one of them is adapted to the different conditions under which it originated. The Egyptian soul-conception now appears to us crude and pagan, but in its time it fulfilled

its purpose and offered comfort and consolation to the worshipers of Osiris in the hour of death. It also contained wrong notions which affected Egyptian life injuriously, but the superstitions might easily have been obliterated if the philosophical development of the people had been such as to gradually purify their religious life, and a similar verdict may be rendered concerning all other soul-conceptions. Every one of them has been instinctively thought out for the purpose of illustrating a truth which the people could not otherwise understand and which even by the leading spirits of the age was sometimes only dimly felt. And the Christian soul-conception of the present day likewise serves in its way a good purpose. But it can easily have injurious effects if the allegorical features are accepted too literally and thus obliterate the truth or lead to superstitious beliefs and practices. Thus the different religious soul-conceptions may be altogether wrong, yet they are in certain aspects *as if they were true*. They drive home a truth by a simile or parable and the only mistake of devotees is in taking the allegory of their dogmas seriously and letting the letter that killeth prevail.

We will not enter here into argument as to the nature of immortality which rightly holds an important place in all religions, but we will point out a contrast between two opposite truths; one is the permanence of all events, the other is their transiency. We must know that the bodily organism will be dissolved into its elements, and all its functions—its reasoning, its feeling and consciousness—will be gone forever; on the other hand it is undeniable that causes endure in their effects. Whatever man does will remain after him a living factor continuing to influence the world. The latter is as true as the former and constitutes the basis of man's belief in immortality.

Man instinctively feels that he cannot be wiped out in death and that the world will not go on as if he never

existed. His life, his personality, his aspirations and labor can not be lost, but must abide for time to come. This is a truth of obviously great significance, for it will influence our actions and will enter into our decisions as an essential factor.

Our life does not begin with birth nor does it conclude with death. It is only a section of the development of mankind before and after us. We existed before we were born and we reap what the factors of our being have sown. So our life leaves its after effects and they will be what we have made them. The man who lives thoughtlessly will be uninfluenced by any thought of the life to come, while the man who believes in immortality will (at any rate under certain circumstances) discipline himself so that his life will presumably be better or, let me say, more in correspondence with the demands of the universal development of all life. The truth is that while there is no immortality in the sense in which most religions hold it if we accept their doctrines in their literal meaning, conditions in life are such in many respects, as if these doctrines were true. For while our bodily existence is wiped out (as we have stated above) with all its physiological functions, the essential part of our own being—the thoughts themselves—remain; and thus our immortality (not as a concrete individual and bodily incarnation, but our soul, our character, the impulses which we have given in life to others, our aspirations and most characteristic features) can not be wiped out. A man who keeps this thought in his mind, either intuitively by realizing the power and justice of the religious instinct, or by having fathomed the problem philosophically in its very depths, will not live for the present moment, but in consideration of the after-effects which his life leaves on the world. And I would say that one of the best tests for right action in a critical situation, is for a man to ask himself, If I had

passed away from this life what would I wish that I had done in this emergency? I am confident that the answer given to this question would help us in the most difficult circumstances to find the right solution.

* * *

Several inquiries from readers of my writings concerning the exact nature of my belief in immortality have induced me to revert once more to this much mooted subject and add to my former expositions of the soul problem a few additional explanations. I cherished the fond hope that my treatment had been sufficiently clear and that my position had been lucidly set forth; but it appears that the middle ground which I occupy, combining the most radical position of unbelief with a sympathetic attitude toward belief and recognizing the truth which lies concealed in the allegory of religious doctrines, is puzzling to not a few thinkers who either would be ready to agree with my solutions without accepting my way of expressing them, or perhaps on the other hand would accept the formulation of my answer but attach to it a different, a religiously dogmatic, meaning.

As a matter of principle I limit the data from which I derive my conception to those facts that are of common experience and can be verified by the critical methods commonly called scientific. While I take note of different religious beliefs and so-called revelations, I do not propose to accept any one of the doctrines involved therein. I simply regard the existence of a certain belief as a notable indication of a corresponding psychical condition, viz., a human want and its satisfaction. Further I do not deem it proper to lay much stress upon statements of abnormal phenomena such as have engrossed the attention of the Society for Psychical Research. Their facts, like those of special revelation, are closely interwoven with theories

and can not be verified to the satisfaction of any one except the observers themselves or those who share their views.

The most important experiments which, if proved, would cause us to revise our scientific views, are mind transference without any means or vehicle of transmission (so-called telepathy) and intercourse with the dead, but both are of such a nature that they give ample room for self-delusion and fraud; accordingly we can scarcely expect satisfactory results of any kind. Here the work of the Society for Psychical Research has been most valuable. In spite of the enthusiasm of its members and in spite of their untiring energy as well as sacrifices of all kinds brought for their cause, the case remains *non liquet*. Nothing has been brought to light that could be used as scientific evidence, and wherever fully established, they only furnish us with facts which are as true as the normal phenomena.

We must bear in mind the rôle that accident plays in life; and one or two or even a few startling occurrences of a certain kind are insufficient as the basis for a theory — that evolves far-reaching consequences as to the essential nature of the soul. We must further bear in mind that many, or even most, perhaps all, experiences admit of an interpretation that would make them reveal no other laws than can be obtained from an observation of normal phenomena. As to the subject matter of alleged communications from the dead, we have to add another objection which consists of a charge of irrelevancy.

There are instances of abnormal soul-life which must be regarded as well established, such as somnambulism, or a display of mental activity in sleep, hypnotism, double personality, etc. I might here also mention the frequent success of faith cure and Christian science. All extraordinary conditions are instructive, but they do not teach

us anything new concerning the soul. They are merely exaggerated cases of the normal activity of the soul.

Though the several religious beliefs of immortality which in their general intentions are sympathetic to me, are not tenable before the tribunal of science, I am fully convinced that the nucleus of truth which they contain makes them valuable and renders them of service within certain limitations. They originated naturally under definite needs, and in their several solutions we find embodied deep truths concerning man's after-life. Man is not annihilated by death; his life is not as if it had been writ in water; his soul remains a living factor even in this present world. So the Mazdaian, the Buddhist, the Brahman, the Christian, and other views of immortality are products of an instinctive groping for the truth, and also state the truth in terms most congenial to their several devotees according to their various conditions of life. These several solutions are not true in all their details, but they are as if they were true. They may be regarded as allegories true in spirit but not in the letter; they are statements positively untrue in the letter, yet animated with certain tendencies which are true in the significance which they endeavor to express. They are like fairy tales with a wholesome moral; the tale is fiction, the moral is true. They are helpful in enforcing right rules of conduct and so though untrue if taken literally, they are true in their purpose; they can be used as a working hypothesis, because they are *as if true*.

It is this *as if true* which constitutes one of the main difficulties of the immortality problem. This *as if true* has induced many serious thinkers to retain the untrue formulation or some traditional solution in spite of its palpable untenableness; and this *as if true* is the weightiest evidence against the bare and bald negation of immortality in whatever form it may appear. It will be worth while

to ponder on this undeniable fact that the several solutions of the immortality problem are *as if true*. They may be contradictory one of another, yea, each one of them may in its literal meaning be self-contradictory; yet if we make allowances for religious allegory which uses the language of poetry and gives instruction by the method of fairy tales, we shall appreciate their paramount significance in the life of mankind and will understand the continued use of them even among unbelievers. There is no objection to them provided we bear in mind that they are poetry and not science; and the truth which they contain shall not be less dear to us if we know that the multitudes need parables, while only the few can grasp their full meaning.

THE SPIRITUAL BODY.

St. Paul, the apostle, says in 1 Cor. xv. 42-49:

"So also is the resurrection of the dead. It is sown in corruption; it is raised in incorruption:

"It is sown in dishonor; it is raised in glory: it is sown in weakness; it is raised in power:

"It is sown a natural body; it is raised a spiritual body. There is a natural body, and there is a spiritual body.

"And so it is written, The first man Adam was made a living soul; the last man Adam was made a quickening spirit.

"Howbeit that was not first which is spiritual, but that which is natural; and afterward that which is spiritual.

"The first man is of the earth, earthy; the second man is the Lord from heaven.

"As is the earthy, such are they also that are earthy: and as is the heavenly, such are they also that are heavenly.

"And as we have borne the image of the earthy, we shall also bear the image of the heavenly."

In explanation of this passage we must inform the reader that the word "natural" is more an interpretation

than a translation, and ought to be replaced in a literal version by "psychical"; while the word "spiritual" is the Greek "pneumatical."²

The apostle distinguishes three bodies,—the body of flesh, the psychical body, and the pneumatical or spiritual body, and in doing so he adopts a system prevalent among the gnostics whose philosophy resulted from a syncretism of all those religious ideas that were in vogue among neo-Platonists and kindred schools shortly before the beginning of the Christian era.

Plato distinguishes between the soul and the spirit,—the soul or *psyche*,³ and the spirit or *pneuma*.⁴ The *psyche* is the realm of sentiment, desire, passion, yearning, etc., while the spirit is the domain of comprehension, of understanding, of intellectual vision. Feelings are apt to interfere with a rational view of things so as to blur the eye of the mind, and thus Plato regarded the *psyche*, the animal soul, as one of the lower faculties of man. The master of the ship of life should not be the soul but the spirit, the *pneuma*, which alone is the divine part of man. It is a Platonic idea when Christ declares that God is *pneuma*.

We note in this connection that the authorized version translates this passage "God is a spirit" while the original reads "God is spirit."⁵

If spirit is connected with activity so as to be a conscious personality it is called in Greek *nous*,⁶ i. e., "under-

²The proper English form of the Greek term *πνευματικόν* is "pneumatic," but it is a pity that this word has been usurped since the invention of the bicycle to designate the air-filled rubber tire, and to obviate the ludicrous association which would naturally be attached to the use of the word in a religious connotation, we prefer in this connection to introduce the word "pneumatical." Although the Latinized ending on the Greek root is not commendable, still it is excused by the existence of the analogous form "psychical."

³ψυχή.

⁴πνεῦμα.

⁵πνεῦμα ὁ Θεός. Literally "Spirit is the God" but "the God" in Plato's language means "God" as "the only God" in a monotheistic sense, and "spirit" is predicate as indicated by the lack of the article. Therefore an inversion of the order of words is justified to indicate the grammatical construction.

⁶νοῦς.

standing or mind," and Anaxagoras of Klazomanæ was (according to Aristotle) the first philosopher who attributed the quality of premeditating thought to God, declaring that God is mind or understanding (*nous*). This monotheistic God-conception was so great an improvement upon the established religious views of his age that Anaxagoras, though a personal friend of Pericles and other influential men, was duly persecuted for impiety and atheism, and had to flee for his life from Athens to Lampsakos.

St. Paul's theory of the three bodies is not a Hebrew doctrine, but typically Greek, or rather Hellenistic, a term which applies to the latest phase of Greek literature when Alexandria had become a center of learning and many Oriental thoughts had become assimilated to the Greek world-conception; producing the gnostic movement, the precursor of Christianity.

The gnostics believed that in the course of man's development the body of flesh is first. It is the husk in which the grain of the soul develops; but in its turn the soul (that is to say the seat of feeling and longing, or as we might say "the animal soul") is not the end of man's destiny. The man of strong sentiment is lower than the man of clear thought, and so the organism of sensations and sentiments is to be regarded as another husk under which the grain of the spirit grows.

The apostle proves the resurrection of the dead in the same epistle (xv. 36-37) as follows:

"Thou fool, that which thou sowest is not quickened, except it die:

"And that which thou sowest, thou sowest not that body that shall be, but bare grain, it may chance of wheat or of some other grain."

He selects an example of nature. The grain of wheat is sown and a new blade is raised with ears full of grain and this simile, as Dr. Radau proves in his article on "Be-

the Christ of Ancient Times," (*The Monist*, XIV, especially pages 96-112) is an echo of the ancient Babylonian religion, where Marduk the god of vegetation descends to the place of the dead and rises from the grave to a new life in the spring festival, the Babylonian Easter. His wife Tsarpanitum is popularly called Zer-Banitu, which means "the one who creates or produces seed" (*ibid.* pp. 109-110).

Paul was a Jew by birth but he was born and raised in Tarsus, a city in the southeast corner of Asia minor, which was well known for its learning and great religious interest. Its schools were famous and we know of two tutors of emperors who had studied there,—Athenodorus, the tutor of Augustus; and Nestor, the tutor of Tiberius. Apollonius of Tyana, the prominent representative of gnostic thought, so much like Paul in many of his views, had studied the art of healing at Tarsus. Rome had given to Tarsus municipal freedom, the highest honor which in those days could be bestowed upon any community within the dominion of the Roman empire, and we know that Paul frequently made use of his privilege of being a Roman citizen. Though it is not probable that he attended University lectures at Tarsus, it is incredible that the many gnostic ideas that pervade the apostle's doctrines should not have come to him in his early childhood, for they are to him natural and self-evident truths which need no demonstration; while his particular Jewish tenets, especially the recognition of Jesus as the Messiah, is the new gospel which he preaches to the world and endeavors to prove by argument.

Paul's view of the three bodies must have been known to the Corinthian congregation whom the apostle addresses. He does not stop to explain the terms and thus it is evident that they form part of the philosophical atmosphere of the age. The apostle declares that as the seed is enveloped

in several husks so the immortal spirit of man grows underneath the husks of the body and of the soul. The spirit alone is immortal. The soul or *psyche* is transient and subject to corruption and dishonor as much as the body and flesh.

When Christianity found its main support in Rome the leaders of Christian thought no longer understood the difference between *psyche*, or "animal soul," and *pneuma* or "spirit," and thus they neglected to discriminate between the two, the soul or *anima*, and the spirit or *animus*. Both were practically identical to the Romans.

The Vulgate translates the word "psychical" by *animale*, which is quite appropriate in so far as according to Plato's views animals have a soul, while men in addition to a soul have also a spirit.

Let us bear in mind the original meaning of St. Paul's passage and let us augment it by another passage in the same epistle, chapter ii. 14-15, where we read:

"But the natural man receiveth not the things of the Spirit of God: for they are foolishness unto him: neither can he know them, because they are spiritually discerned."

"But he that is spiritual judgeth all things, yet he himself is judged of no man."

The spiritual body is not born but must be acquired during our life. The psychical body is the life principle which makes it possible for us in common with all animals to live and to feel. God is possessed neither of a body and flesh, nor of a soul. God is (as we read in the Four Gospel) pure spirit or *pneuma*. Man becomes immortal by partaking of the spirit or the *pneuma* of God. The more man partakes of the spirit, the more he develops spirituality,—what Paul calls the "spiritual body." The aim and purpose of mankind is the development of the "spiritual" man. By being spiritual, man becomes God.

¹ ψυχικός.

like, and the purely spiritual man is the God-man, or Christ. Man in his natural state is on the same level as the animals. He is mortal and is possessed of a *psyche*, a soul, or a psychical body only. The psychical man is called the first man or Adam, the spiritual man is called the second Adam, and here St. Paul adopts a term of the Jewish Cabala. The teachings of St. Paul always deal with the significance of the spiritual or pneumatical in contrast to the psychical, i. e., the material or sentient, or the animal soul.

All the blessings which proceed from God are spiritual or pneumatical, so Paul says in Rom. vii. 14, "The law is spiritual, but I am carnal,"

ὁ νόμος πνευματικός ἐστίν, ἐγὼ δὲ σάρκινός εἰμι.

and again in Rom. i. 11, he expresses his anxiety to see the Romans to give them a "spiritual gift."⁸ He further admonishes the Romans to take up a collection for the impoverished congregation at Jerusalem, on the plea that the Gentiles owe the Jews a debt, because they (the Gentiles) have been made partakers of the spiritual things⁹ of the Jews. St. Paul explains the manna in the desert and the water of the rock struck by Moses to be spiritual food wherewith the Israelites had been kept alive by God.¹⁰

The religious devotion of the gnostic movement found expression in congregational hymns, addressed to the deity. Philo mentions this fact of the Therapeutæ of Egypt, and we know that the same custom obtained among the early Christians. Paul speaks of them in Eph. v. 19, and Col. iii. 16 as psalms and hymns and spiritual songs.¹¹

The Apostle declares in 1 Cor. xii-xiii that God manifests himself in a variety of spiritual gifts such as wisdom,

⁸ χάρισμα πνευματικόν.

⁹ τὰ πνευματικά.

¹⁰ 1 Cor. x. 3, cf. Ex. xvi. 15ff.; 1 Cor. x. 4, cf. Ex. xvii. 6.

¹¹ ψαλμοὶ καὶ ὕμνοι καὶ ᾠδαὶ πνευματικαί.

knowledge, prophecy, faith, the gift of healing, the working of miracles, diversities of tongues, the interpretation of tongues, etc., and charity the greatest of all (ch. xiii), and he admonishes the Corinthians that all are equally members of the same body which is Christ.

If we now try to translate into scientific terms the language of St. Paul, we will understand that these notions are not mere fancies but that they are based upon practical experiences and are definable from the standpoint of positive psychology and philosophy. Man's existence is not limited to the physiological functions of his body. His interior life consists of feelings concentrated in consciousness. Modern psychology, or more exactly psychophysics, explains the psychical condition of man as the concomitant of physiological functions. The soul of man (soul understood in the same sense in which Plato speaks, as *anima* soul) is not immortal. The immortal part of man is his spirit.

All the psychical features of man are one aspect only of his life. They do not exist by themselves and are so many abstractions. Such are the sensations of touch, sight, hearing, etc., emotions, volitions, and kindred feelings. They are psychical and not corporeal; they are states of consciousness, not bodily objects, and we must know that if their totality is spoken of as constituting a body, we have to take the statement *cum grano salis*. It is a mere allegory which may be considered as true in so far only as all psychical dispositions of man constitute an organic whole, a hieratic system, which is quite analogous to the body of a living organism.

When trying to understand the language of St. Paul we must allow him to speak of the system of psychical functions as the "psychical body." In defense of this way of speaking we might say that the Brahmans and the Chinese also use the term "body" figuratively in the sense of "sys-

tem." The entirety of the laws that constitute the world order is spoken of in the Buddhist Mahayana school as the body of the law which is the eternal Buddha, in the sense of the Christian *logos*, that was in the beginning, viz., the world-order or the system of eternal laws.

The idea of a psychical body originates naturally and necessarily in a primitive age of civilization, and may not improperly be called the dream body. When man falls asleep his body of flesh lies quiet on the couch, but his soul remains active, he dreams. He roams about at distant places in a body that is not subject to the laws of matter. The dreamer meets persons that have died and they, too, appear in a similar bodily shape. Such was the Egyptian idea of the luminous body, the Homeric idea of the shade, and other kindred notions, many of which have come down to our present time, and we cannot doubt that they are kin to the gnostic idea of a psychical body.

We now ask, what is spirit? Spirit in the language of the gnostics is the highest efflorescence of the soul. The soul contains the germ of the spirit, but though the spirit grows within the soul, it comes from God. The result of man's psychic life is comprehension, and comprehension no longer partakes of sentiency, or passion, or desire. It rises into a new realm, the spiritual world, which in modern language we would call the domain of abstract thought.

Abstract thought is not feeling and must not be identified with sentiency. That it originated through sentiency by experience in the material world, is not disputed, but it is claimed to be radically different from the latter in partaking of the nature of God; and this is true in its way. Sentiency is always particular and exists somewhere at some moment in some sentient creature, while abstract thought formulates general laws which apply anywhere and everywhere. They are universal, omnipresent and eternal.

This important feature of spiritual life, viz., the attainment of that which is eternal, appeals to the gnostics with great power because here they see a chance for man to attain to the divine and to acquire immortality.

If we now ask whether the spiritual of man is actual or a mere illusion, we come to the conclusion that the spiritual indeed is that part of man which imparts to him immortality. It is that which constitutes the humanity of man, that feature which gives him lordship over nature, and we may add, that which makes him kin to God. The rich life of the spirit covers the domain of science, religion, ethics, and has since the origin of man been the factor that is leading him higher and higher in the ladder of evolution.

The realm of man's spirituality constitutes a system as much as does the psychical and the corporeal and so the gnostics speak of a pneumatical or spiritual body, a conception which if not taken too literally is sustained by facts in so far as the spiritual portion of every man is not a disorderly conglomeration of abstract ideas but constitutes a definite organic system extending with its references into the past as well as the future not less than to contemporary events.

Man's personality is not limited to his bodily system even if we include his psychical functions. Our idea of the personality of a man includes his rights, his possessions and his accomplishments reaching out to things inanimate, conditioning, determining and shaping the surrounding world according to his power and privileges. His signature indicates his will and disposes of his bank account as if he paid out the sums indicated thereby in his own bodily personality. The spirit of an author is present wherever his books go, and it affects the people who read them.

Thus we see that the spirit of man rules in a sphere that is superadded to his psychical life, and though the

psychical may pass away, the spiritual or pneumatical will endure.

In Roman law the idea was adopted that the will of a man can extend beyond his life, and bequests are based on the idea that they represent the will of the deceased. The testament or last will is respected as much as if the man who made the will were still alive. It may be set aside on the same grounds that the request of a living man under certain conditions becomes objectionable, not otherwise.

If we apply this view of a spiritual existence to all the factors of life, we can not deny that man during his life is building up for himself a spiritual body, and that when he dies this spiritual body will continue after him. According to his deeds it will assure him an immortality within the domain of human society as well as generally in the history of the world. A man lives on in an institution which he has founded as much as if he had remained in life, so long as his spirit continues to be the dominant factor in its administration. The spirit of Shakespeare, of Goethe, of any poet and also of any statesman who has helped to shape ever so remotely the conditions of our present life, is incorporated in the general spirit of mankind, and has thus acquired an immortality that is not subject to corruption.

This spiritual condition was spoken of by Christ as the treasures which neither moth nor rust doth corrupt, and where thieves do not break through or steal.

We must notice in this connection that consciousness, sense-activity and the entire realm of sentiment, being the psychical body, will have no part in the immortality of the spirit. Consciousness together with all feeling is clearly affiliated with bodily life. Accordingly it partakes of the corruption of the body of flesh; it is subject to transiency, being limited to the particular, to the present moment, to a definite function of the corporeal. It is disturbed by

disturbances of the corporeal body and passes away with its corporeal substratum. Consciousness, accordingly, should not, on the basis of the gnostic philosophy (adopted by St. Paul) be considered as a portion of the divinity of man. It is sentiency and so it is subject to all the faults of sense-life.

While there is no doubt that consciousness is a state of feeling, intensified by concentration, (and accordingly should be regarded as a function of the psychical body not of the spiritual body), we are aware of the fact that the apostle did not draw this conclusion. Nor must we expect of him a strict logical consistency, for he was a preacher and not a professor, a moral leader, not a logician, a prophet, not a philosopher. For his practical work as a preacher and teacher, he could make better use of the hazy idea of a spiritual immortality in which the psychical element of consciousness was tacitly retained.

Man is essentially a sense-being. He clings to the material, to the sensual, to the particular, and looks upon the spiritual, the general, the universal, the supersensual, as mere nonentities, and thus in the progress of Christianity the persistence of consciousness has always been made the most essential part of man's immortality. The higher ideals of life being mere abstractions are said to count for nothing unless man preserves exactly this same consciousness of the identity of his personality. The founder of an institution, it is sometimes claimed, is little benefited by the persistence of his intentions, by the good service he rendered to his fellow beings, by the actualization of his will, unless he knows of it and is conscious of the fact. The fact itself, it is claimed, counts for nothing if consciousness is eliminated.

Man's after life is spiritual, and, as Paul says, not psychical. The psychical is transient while the spiritual endures. Nevertheless the psychical element is not absent,

for the memories of future generations in whom the departed spirits continue to live are aglow with consciousness, and the spiritual body of past generations animates the psychical life of the present and utilizes it as its own. Therefore we may say that, although the psychical functions of each individual become extinct in death, man's life after death is such as if they continued; and it is quite natural that almost all religions represent man's immortality as a continued state of consciousness. Man's personality remains after death a living presence, and this living presence makes its influence felt *as if* he were conscious of it. He draws, as it were, on the consciousness of the living, he utilizes their vitality, their sense organs, their sentiments, and so the people who believe in a conscious immortality are after all not far from the truth.

* * *

We will now discuss the idea of a spiritual body as Professor Fechner held it.

Fechner's theory of the soul, and also of its immortality is based on the doctrine of psychophysical parallelism which explains all psychical phenomena as concomitant to physical functions. All ideas, sensations, and sentiments which we experience, are accompanied by a definite commotion in some definite part of the brain, and *vice versa*, some brain-motions are accompanied by feelings. What is objectively a function of cerebral structure manifests itself subjectively as a state of consciousness.

This view, with but insignificant modifications, is recognized by all psychologists of standing, but Fechner makes a peculiar application of it not only to the plant world, but also to inorganic processes, to the planets, the sun and the stars, in so far as he claims that the objective world is throughout animated by analogous feelings, and though in our present life our consciousness is limited to

our physiological system, he states that after death it will be transferred to our spiritual personality which we have created during life. His view of immortality is unique in so far as it is a rare combination of truly scientific ideas with fantastic notions. We deem his work worthy of a careful perusal because he succeeds in pointing out the significance of the spiritual body and picturing its reality with the accuracy of a naturalist. This latter feature of Fechner's psychology tallies with our own convictions, and it is therefore well worth mentioning that both Fechner's and our own views, have been worked out in perfect independence—a fact that goes not a little way in proof of their truth. We have been familiar with Fechner's general doctrines but we have only lately devoted our special attention to his "little book on life after death."

Fechner in his book *On Life After Death*,¹² explains the significance of spiritual life and points out that man is actually preparing during his life a new and higher type of existence which will bear the stamp of his personality. It is generally conceded that the dead continue to exist in the memories of the living, but Fechner goes further, he insists on the reality of these memories which constitute the vehicle of man's personality in his life after death, and his arguments are convincing; yet he fails in one essential point.

Fechner claims that at the moment of death man's consciousness is transferred to his spiritual body, and that thus the soul exchanges its present habitat for a more ethereal existence. While we agree with him that the spiritual body of the deceased person is immortal, and that through it, in it and with it, he continues to live, we find no reason to assume that the soul or psychical body passes out in an actual and local transmigration into another place where

¹² Translated from the German by Hugo Wernecke. Chicago: The Open Court Publishing Co., 1906.

the spiritual body may happen to be. Death is simply a dissolution of our corporeal existence, and in the body of flesh, consciousness ceases. There is no migration of either a soul or a spirit for the simple reason that neither of them can travel from one place to another. The animal soul (that is to say the *psyche*, in the narrow sense of the gnostics), depends on the psychological functions of the brain, and with the destruction of the brain it ceases, but for that reason death is not merely the extinction of life. It is not the purely negative act of ceasing to exist. It has its positive aspect which may be called a finale and a climax. Death is like the conclusion of a book, or the last line of a poem, and summing up all that has been said, it is the consummation of life. The death of different persons may be of different importance. The death of Giordano Bruno was a death of heroism which raises him to the rank of a martyr of truth; and the same is true in a higher degree of Christ, whose death on the cross made him worthy to be regarded as the Saviour, the Christ, the Messiah.

The spiritual body may or may not be modified by the death of a man. The death of a man may have an effect upon his spiritual personality, but after all the spiritual body is to be built up mainly during our life by our thoughts, our words, and our deeds. Our immortality accordingly is not our birthright, but it is of our own making and must be worked out by us during our life in the flesh.

The consummation of our lives by death renders our spiritual existence more stable and unchangeable, and will also give it in many cases a greater solemnity, but otherwise it can change nothing in its constitution. The ceasing of consciousness here can not produce the appearance of consciousness there, yet we would not deny that the reality of our spiritual existence after death is assuredly

not less than it was at the time of life, and we will probably not be contradicted by any one when we claim that the spiritual existence of man is not less superior to the psychical than the psychical is to the corporeal. What would a man be if his spiritual personality were cut off, and he would be reduced to his animal soul only, remaining in possession of his feelings and bodily powers while he is shorn of his intellectual accomplishments, together with all his social, financial, and other human prerogatives! He would merely vegetate and would have to be taken care of in an asylum in the condition of an animal that is endowed with a human body. In his spiritual personality man grows beyond his bodily self and in a domain of purely relational elements in the realm of pure form, he builds himself up a spiritual existence, that will serve him as a mansion for eternity. Our body of flesh will die and decay, but this intangible system of conditions created by our thoughts, words and actions during our pilgrimage on earth will endure. He is wise who makes it his headquarters while still in life for it will be our home when the tabernacle of our body of flesh has given out.

Here Fechner has not yet overcome the sensualism of the traditional soul-conception, and we can think of no scientifically tenable argument that would favor his proposition. But when we grant Fechner that man's spiritual existence in life after death is a real factor, concrete, personal, and actual, we will also add that it manifests itself *as if* this life were carved by a personality endowed with consciousness, and no one can blame us if we introduce this as a feature of it by figure of speech. If we are permitted to interpret Fechner in this sense, we shall find his theory recommendable.

We will not dwell long on the points where we cannot agree with Fechner. They are all corollaries of the proposition that "in the moment of death, man will all at once

became conscious of all the ideas and effects of his actions in life" (p. 36). According to Fechner our bodily frame "holds us in bonds" which must be undone in death to give us the higher consciousness of our union with other spirits (pp. 66-67, 75), and when in death "eternal night sinks down on man's bodily eyes, a new day will break upon his spirit" (p. 76). Fechner claims that we shall no longer need our eyes because we acquire a new and higher kind of vision (pp. 82f.; p. 120), such as only the sun and all the planets possess, when emitting and intercepting rays of light.

Fechner seems to accept telepathy as a fact—not telepathy as we explain it, or as Goethe understands it in his poem *Wirkung in die Ferne*, but as an influence "without the mediation of mouth, ear, or hand" (p. 79, cf. p. 59).

To Fechner it is no mere figure of speech when he says "You will be able at will to make a dead person happy or miserable" (p. 62). We do not deny the deep truth of this conception, but we would not accept it in the literal sense that Fechner does. A dead mother will be a living presence with her child, her memory will prove a blessing, if it be kept sacred, it will prove a support in temptation and a comfort in affliction, and if he follows her guidance and remains worthy of her, her picture will be cheerful, she will become a source of joy and happiness. I say here purposely "she," for the mother's memory picture in the heart of her child is one of the mansions which she builds up during life-time, and in it she has taken up her abode. I agree fully and wholly with Fechner as to the reality of this spiritual existence of ours that will be illumined with consciousness as furnished by the physiological constitution of the son, but at the same time I draw the line when Fechner ensouls the entire system of this higher life of the departed with feelings which to our knowledge are only concomitants of physiological processes.

The same is true of ghosts. Fechner says:

"You have also heard of ghosts appearing—what the doctors call phantasms or hallucinations. They are indeed hallucinations of the living, but, at the same time, real manifestations of the dead. The faint images in our memory are such manifestations, those vivid apparitions are only the more so. It is no use worrying whether they be one thing or the other, for they are really both things at a time. And as you are not frightened by the images within you, being present manifestations of spirits, you need no more be frightened before the apparitions before you."

Certainly the hallucinations of Macbeth are real to him and the murdered king is truly present in his mind, but for all that there are no ghosts, no hovering spooks and phantoms who manifest themselves.

According to Fechner the dead possess not only their spiritual body which they have built up during their lifetime, but in addition also a peculiar kind of consciousness which is a continuation of the consciousness of their earthly life whence it is transferred into the spiritual body in the moment of death.

We can not follow Fechner in this most significant point of his doctrine of immortality. Here he deviates from the strict principles of science and allows himself to be carried along with his wishes, his hopes, and his faith. Yet we will gladly make the same concession to him that we make to religious doctrines. His view though untenable in its literal meaning, is *as if true*; it incorporates a truth that is significant and that should not be denied.

We conclude with a condensed and generalized statement of our proposition which may be summed up thus: the doctrines of immortality, formulated by the several religious faiths, are forcible and poetic descriptions of the

fulfilment of legitimate wants of the human heart; these several descriptions are not exact scientific statements and are, one by one, untenable in their literal significance, if tested by a severe and rigorous critique. Yet it would be *wrong* to discard them off-hand as errors or superstitions, for *a*fter all, they are as if they were true. The wants of the human heart which are therein expressed find a glorious fulfilment in every way that, judiciously considered, man may expect. If man had the wisdom of omniscience, he *would* be satisfied with the world-order as it is, and also with the fate that awaits him after death.

EDITOR.

THE EXPERIMENTAL DATA OF THE MUTATION THEORY.

B. EXPERIMENTS WITH OENOTHERA.*

CONVINCED that the origin of specific characters should be amenable to experimental investigations, Professor De Vries began in 1886 a search for suitable material for his researches. He brought more than one hundred species of the native and introduced flora to his garden; his purpose in doing this was not their improvement by selection but simply to secure convenience and accuracy of observation which would have been quite impossible with the plants still in the open. One of the species, however, showed itself quite different from the others, and the history of this form we shall now relate in its main points, as briefly as possible.

In a deserted potato field near Hilversum an American primrose, *Oenothera Lamarckiana*, often cultivated in the European gardens and running wild extensively, had been growing for about ten years as an escape from a neighboring source and had taken possession of about half of the field where it was represented by hundreds of individuals when the spot was noticed in 1885. The plants showed the usual fluctuating variability in a pronounced degree as well as occasional malformations, such as fasciations and the transformation of leaves into conical pitchers, but

* A review of the comparative data of the mutation theory and of the insufficiency of selection appeared in this journal for October, 1904.

it was not until the next summer that the most important discovery was made.

Then two groups of plants, each of only a few individuals, but of a well characterized and distinct form, were discovered, and it seemed at once evident that these belonged to a new elementary species and that it was not improbable from their limited areas of distribution that they had each sprung from the seed of a single individual. No comparable forms were found in the great herbaria at Leiden, Paris or Kew. More significant still, the forms showed themselves constant in culture from the first. One of the new species was designated as *Oenothera brevistylis* because of the much shorter style, while the other, with smooth leaves and much handsomer foliage than *O. Lamarckiana* and conspicuous for the habit of producing petals which lack the notch at the margin, was called *O. laevifolia*.

The characteristics separating these species from the parent, *O. Lamarckiana*, are many and not merely those given above, but here, as with all other species mentioned in this paper, space cannot be given to detailed descriptions which would hardly be of interest to the general reader. Nor can we attempt to describe in any detail the series of laborious cultural experiments which followed the discovery of the two new elementary species in the deserted potato field at Hilversum. The merest outline must suffice, for it is the object of the present paper with its limited space to present the philosophy of the mutation theory as compared with the theory of fluctuating variations with just enough illustrative examples, rather than to give a detailed review or criticism of the data upon which the theory rests.

In the fall of 1886 two lots of material of *O. Lamarckiana* were selected for the experimental garden at Amsterdam. The first consisted of nine rosettes, and the second

a quantity of seed. Besides these, seed was collected from the newly discovered *O. laevifolia* and plants of *O. bristylis* were taken bodily. Occasionally seed was taken from the original locality for check tests.

In accordance with the terminology of sugar beet selection the first three groups were designated as families and as such have been cultivated to the present time.

The descendants of the rosettes formed the *Lamarckiana* family, those from the seed of the *O. laevifolia* the *Laevifolia* family, and from the seed of the five-celled *Lamarckiana* fruit came a group designated as the *Lamarckiana* family. We may confine our attention here to the *Lamarckiana* family.

The rosettes taken from the field at Hilversum flowered in an isolated bed and produced an abundance of seed from which, as the second generation, about fifteen thousand individuals were produced, among which were found two forms not seen before. These were distinguished as *O. nanella* and *O. lata* and were represented by five individuals each.

Six typical specimens of *Lamarckiana* served as seed plants, and in the third generation of about ten thousand individuals three each of the two new forms mentioned appeared, and in addition *O. rubrinervis*, of which one specimen was observed.

For the sake of improving methods of cultivation and artificial pollination it was necessary to discontinue further cultivation of the *Lamarckiana* family for a time but when it was again resumed four years later, the fourth generation of about fourteen thousand plants was found to contain three hundred and thirty-four of the mutant individuals, of which one-half belonged to four forms which had not yet shown themselves in the cultures, *gigas*, *O. albida*, *O. oblonga* and *O. scintillans*. The cultivation was conducted for four generations more with a great

or lesser number of individuals, and always with a number of the newly originated forms though no more new types appeared in these later generations. In all of these, however, the total number of individuals was less than that of the fourth generation alone. The eight generations numbered about fifty thousand individuals of which about eight hundred were mutants belonging to seven new elementary species. Of these, but one appeared only a single time.

During the first years of the experiment the plants were so isolated that there was no danger of crossing with any other form, but later the flowers were covered with transparent paper bags and self-fertilized so there could be no possibility of hybridity. It is thus certain that the ancestors of each of these eight hundred new forms produced between 1888 and 1899 had had typical *O. Lamarckiana* ancestors as far back as 1886 and in all probability much further.

For the botanical specialist it would be highly desirable to present detailed descriptions of these new species, but it would be of little interest to the general reader, and it must suffice to say that, though the differences are small, they are many and so well defined that there is no danger of mistaking the new forms. Indeed some of them may be at once recognized in the seedling stages, though others require a greater degree of maturity to exhibit their characteristics. It is altogether probable that one and one-half per cent. does not represent the total number of distinctly new forms, since it was necessary to weed out the most of the individuals as soon as they showed distinctive characters, and it is quite probable that some of these examples cast aside as typical *O. Lamarckiana* would have later, perhaps when flowering, shown themselves to be separable from the parent by well defined differences. A brief account of the origin of these new forms and their conduct

under cultivation will be much more profitable than technical descriptions.

O. gigas was the only one of the seven forms which was observed but a single time in the *Lamarckiana* family. In the other families it appeared but twice. This single individual which had had for at least three generations typical *O. Lamarckiana* as ancestors, formed the beginning of the new species *O. gigas*. From the seed of this self-fertilized individual there were grown over four hundred and fifty plants. These were conspicuous for their constancy to the new specific type which differed clearly and sharply from *O. Lamarckiana*. Only a single aberrant individual was found. This showed the characteristics of *O. gigas* but was a dwarf and so was given the varietal name of *O. gigas nanella*. Not one reverted to the characteristics of the *O. Lamarckiana*. Thus a new elementary species may originate in a single individual and be perfectly constant from the first.

O. albida, occurring every year in greater or lesser numbers in the most of the cultures, is a very characteristic form, at first considered pathological individuals and not counted. Even when it was recognized that this represented a distinct type it was long before the weak plants could be brought to flower and mature fruit. When this was finally accomplished only a few seeds were produced and so the experiment was not an extensive one, but so far as it was carried the form was perfectly constant in the second and third generations.

O. rubrinervis is distinguished from the others by its form and the characteristic red coloration of the veins of the leaves and the stripes on the calyx. It also exhibits a high degree of brittleness due to the limited development, though not entire absence, of the strengthening bast portion of the stem. A slight blow or lack of care in the plucking of a fruit is sufficient to break the stem into a

number of pieces. This characteristic never failed; every plant classed in its rosette stage as *rubrinervis* could be counted on to produce later a very brittle stem and red calyx and fruit. In the year 1896 about one thousand examples of this species were grown from seed produced by eight individuals which had originated immediately from the *O. Lamarckiana* stock the year before. All were typical *rubrinervis* except for two plants. One of these had the characteristics of a new species, here appearing for the first time, and was designated as *O. leptocarpa*, while the other was clearly *O. Lamarckiana*, probably from a seed already in the ground. This plant was naturally the cause of some concern, but all doubt was removed when two check experiments, aggregating nearly three thousand plants, showed the species perfectly constant, and justified the conclusion that *O. rubrinervis* is a good elementary species.

O. oblonga appeared in every generation after the third and in considerable numbers, being recognizable when the seedlings had produced about the sixth leaf. The seed from seven biennial plants produced 1683 seedlings all of which, excepting one with the characteristics of *O. albida*, were typical *O. oblonga*. The seed of the annual plants germinated poorly, only 64 plants being produced. With the exception of one *O. rubrinervis*, all were true. In neither lot were the *O. Lamarckiana* characteristics to be recognized. *O. oblonga* may then be regarded as constant from its first appearance but with the power of producing other new forms.

In the preceding forms and in those which are to follow there is nothing comparable with the results of general horticultural experience with other plants. In *O. nanella*, the dwarf primrose appearing in every generation, we have a form which is very similar to the dwarf varieties which occur in so many cultivated plants.

But some one will at once suggest that such forms are only varieties and not species. In truth these dwarfs may as well be called *O. Lamarckiana nanella* as *O. nanella*. So long as ambiguity does not result, it is quite unessential whether an organism with a given set of characteristics be spoken of as species or variety. The point of real interest is to know whether these characteristics are heritable and constant or whether they are merely the expression of a widely fluctuating variability to be lost in succeeding generations. Since *O. nanella* differs from the parent form in only the one characteristic—that of size—perhaps it may be as well to speak of it as a variety, but if in cultivation it shows itself true to seed it must be remembered that it is as worthy of the name of an elementary species as are other constant forms.

O. nanella is probably the most easily recognized of the new forms, unless it be *O. lata*, throughout its entire development, beginning as early as the second leaf. The first counting for this species, or variety, was made with 440 plantlets, from seed of self-fertilized parents. All of these showed themselves true. As a second experiment twenty individuals, originating immediately and without transition from *O. Lamarckiana*, were self-fertilized and produced 2463 seedlings, all of which were the typical dwarf form. A still more extensive experiment was that in which 36 plants were self-fertilized and produced over 18,000 typical *O. nanella* seedlings, among which the only deviations were three plants showing the additional characteristics of *O. oblonga*, which may therefore be designated as an elementary type of second rank, *O. nanella oblonga*. When *O. nanella* occurred in other families it was very constant. Forms in which the characters of more than one species were noted, as *O. lata nanella*, *O. nanella elliptica*, etc., were very rare.

As soon as the second or third leaf unfolds, the species

known as *O. lata* is recognizable. It appears almost regularly, but in exceedingly variable numbers representing from 0.1 to 1.8 per cent. of the entire culture. In addition to its other characteristics, this form is always purely pistillate, no fertilization with its own scanty pollen ever having succeeded. Crosses with the pollen of *O. Lamarckiana* were almost perfectly fertile and produced in the second generation from 15 to 20 per cent. of *O. lata* plants.

The six new elementary species just described have been characterized by a remarkable degree of constancy, showing in the many thousands of individuals only one plant of *O. Lamarckiana*, and this was without doubt due to a seed in the soil. Only rarely have the new species shown the power of giving rise to other new forms. But in the seventh of the series originating from the main stem of the *Lamarckiana* family during its eight generations, *O. scintillans* shows quite different characteristics. With the exception of *O. gigas* and some others not yet described, *O. scintillans* is the rarest of the new species. With self-fertilization it produces not pure *O. scintillans*, but *O. scintillans*, *O. oblonga*, and *O. Lamarckiana*, and in a more or less definite numerical proportion. Two groups seem to occur, one with 30 to 40 per cent. and the other with about 70 or more per cent. of the offspring true to the parent type.

We have discussed as briefly as possible the plants belonging to the *Lamarckiana* family. Earlier in this paper we referred to other lots of plants which were brought from the field at Hilversum. Each of these families was followed through, generation by generation, by the experimenter, and his results are described in detail under the headings: A Side Branch of the *Lamarckiana* Family, The *Laevifolia* Family, Two *Lata* Families, Mutation in Other Families, and Mutation in Nature. The results of these

investigations confirm those obtained in the *Lamarckian* family so that we need not describe them here.

These "families," as De Vries has termed them, represent the principal experiments carried on for the purpose of observing the origin of new forms. Besides these extensive investigations, however, many sowings and countings were made for other purposes. These all furnish confirmatory evidence in support of the conclusions drawn from the more extensive and longer continued experiments. It may almost be said that mutations occurred in every extensive culture.

In general the new species are less mutable than the original *O. Lamarckiana* from which they spring, but there also occur among the new species very strongly mutable forms such as *O. scintillans*.

In crossing, the tendency to mutation is retained, and when *O. Lamarckiana* is produced from crossing it seems to exhibit the tendency in all its strength. Sowings of *O. leptocarpa*, *O. nanella* and *O. oblonga* proved true to type except for seven individuals in 3410 seedlings counted. The mutants in these cases represent about 0.2 per cent. of the individuals while from the seed of *O. Lamarckiana* from one to three per cent. or more are produced.

O. scintillans is a very mutable new species. On about one-third of the offspring are true to the parent type while the other two-thirds are *O. oblonga* and *O. Lamarckiana* with a few mutants belonging mostly to *O. lata* and *O. nanella*. During six years of cultivation 3 specimens of *O. lata* and 29 of *O. nanella* were found among 7872 seedlings of typical self-fertilized *O. scintillans*. The 67 mutant individuals belonging to the two species represent about 1 per cent. of the total number, a percentage which approaches very closely that yielded by *O. Lamarckiana* itself.

Hybridization seems to increase mutability. The two

parent forms are found in the progeny of these crosses and in case *O. Lamarckiana* is not one of the parents it generally occurs as well. Crosses between *O. Lamarckiana* and *O. nanella* gave during the five years in which the experiment was tried 64 mutant individuals, *O. albida*, *lata*, *oblonga*, *rubrinervis* and *elliptica*, among the 8283 seedlings examined, or about 1 per cent. Among 1586 individuals produced by crossing *O. lata* and *O. nanella* during six years of experimentation, 31 mutated individuals, 15 *O. albida*, 14 *O. oblonga*, and 2 *O. rubrinervis*, were found, or about 2 per cent.

Crossings with the old and accepted species of the systematist, *O. biennis* and *O. suaveolens*, were also tried. *O. Lamarckiana* and the new *O. lata* were crossed with both of these older species and 1352 of the offspring examined. Mutated individuals belonging to the species *oblonga*, *lata*, *nanella*, *elliptica*, *scintillans* and *albida* occurred to the number of 29, or somewhat more than 2 per cent.

In all of these cases, then, the potency for mutation is about the same as in *O. Lamarckiana* itself.

As we have already mentioned, *O. Lamarckiana* itself often appears among the seedlings from crossed individuals. De Vries has made a comparison of the progeny of this species when produced as the result of crossing, with that of the other new species when produced in the same way, and has arrived at the conclusion that if seed be gathered from plants belonging to one of the new forms, results which correspond with those given above for the production of mutants from new forms are secured, that is to say about 0.2 per cent., while if that from self-fertilized *O. Lamarckiana* be sown the same tendency to mutation will be seen in the richness of the beds in mutated individuals.

In 1889 seedlings were raised from *O. Lamarckiana*

plants grown from crosses between *O. Lamarckiana* and *O. nanella*, *O. lata* and *O. Lamarckiana*, *O. lata* and *O. nanella*, and *O. lata* and *O. brevistylis*. In all 43 mutated individuals, belonging to *O. albida*, *lata*, *nanella* and *oblonga*, were found among the 4599 seedlings examined.

About 1 per cent. of mutated individuals in these experiments compares very favorably with the other trials of the mutability of *O. Lamarckiana*, and a general survey of the experiments carried on by Professor De Vries leads us to the conclusion that whatever its source and whatever the number of generations through which it has been cultivated *O. Lamarckiana* retains a very constant potency for mutation. The new species, on the other hand, show their constancy not only by the absence of transition between themselves and reversion to the parent type but by their greatly reduced mutability as well. The capacity for mutation, however, seems to have been transmitted, though in a greatly reduced degree, from the parent to the daughter species, where it is to be seen in the production of an occasional mutant.

The theory of the origin of species by selection has been so long accepted that the term "experimental evolution" conveys at once to the mind a series of experiments in selection or in the modification of organic forms by controlled external forces. To preclude any such misunderstanding of the garden experiments carried on in Amsterdam we must repeat that in the main families described above there was no attempt at selection or the experimental production of mutations, a problem of highest importance for future investigation. The only purpose of the methods employed was to provide a convenient and accurate method of investigating the process which is taking place in nature.

These are two ways of observing mutation as it occurs in nature. The plants may be sought and studied in the

field, or large quantities of seed may be gathered and germinated under conditions favorable for growth and study. The first method is one of exceeding difficulty, and De Vries is the only investigator who has surely succeeded with it even in the most limited degree. The percentage of new forms is so small even when all the seeds are germinated and the number of seeds which reach or at most survive even the seedling stage is so few that this method must be discarded as quite beyond the limits of practicability. With large sowings of seed collected from the plants as they grow in the woods and fields, however, the case is quite different, and we may look with much hope of success to this method. The mutation is already determined in the seed, and germination in the greenhouse or garden affords only the possibility of accurate observation and counting.

Numerous sowings of this kind made by De Vries convinced him that species are for the most part in an immutable condition. It is quite probable, however, that further experiments in different regions will reveal other species which are in the same condition of instability as *O. Lamarckiana*.

Some of the new species of primroses were observed in the original habitat near Hilversum, usually as seedlings or young rosettes, rarely flowering, though two species seemed able to hold their own in competition with the parent form. The second method of search for the mutated individuals was also extensively employed. The following list gives the species observed in the field and those raised from seed collected there.

PLANTS OBSERVED.

O. lata. 1889, 1894.
O. nanella. 1894.
O. spathulata. 1886, 1894.
O. elliptica. 1886.

GROWN FROM SEED.

O. lata. 1887, 1889.
O. nanella. 1889.
O. lata-nanella. 1889.
O. rubrinervis. 1889.

Five of the new species originating in the garden were,

then, also found in nature. They occurred rarely, but usually several times in different years, and in such a manner that the later could not have been derived directly from the earlier individuals. These species are those which appeared most frequently in the experimental garden.

The first observation of a new form must not be regarded as its first appearance. Two of the new species, *O. elliptica* and *O. spathulata*, were found in the deserted potato field upon the first visit in 1886. It seems that the process of mutation was in full progress when the field was first visited. Whether mutation began when *O. Lamarckiana* began spreading over the deserted field or whether this characteristic was a much older one cannot be decided.

Systematic Characteristics of the New Species.

Discussions of questions of nomenclature are uninteresting enough for the scientist and will not be forced upon the general reader; but the source and nature of the material serving for any experiment or series of experiments is a matter of interest as well as of first importance, and before leaving the discussion of the origin of new species from *O. Lamarckiana* we must glance at the history of this species as far as it is known.

While it has shown itself quite constant under cultivation in Europe and America, it is not identical with any known member of the American flora, although it undoubtedly has its closest affinities with an American group. In the earlier European botanical writings, even so far back as 1635, there are references to a large-flowered *Oenothera* cultivated in European gardens, and this may have been the *O. Lamarckiana* as we now know it. De Vries and others have compared material of the species as we know it with the type material examined by Lamarck in the herbarium of the *Musée d'histoire naturelle*. Lamarck

saw neither living material nor specimens collected in the American habitat; his descriptions were prepared from dried specimens of plants cultivated in the garden of the museum. Two suggestions as to its possible origin seem most plausible; *O. Lamarckiana* may have been a species with limited distribution in "Virginia," as the region from which so many American plants were first taken to Europe was designated in the old herbals, and since then may have become extinct through the exploitation of the region by cultivation, or it may itself have originated by mutation from some other species in European gardens. Since that time, for over a hundred years, *O. Lamarckiana* has proved a constant type. And whatever may have been its origin, there can be no possible objection to its use as a subject for experimentation and one must express some surprise at the light way in which the results of these experiments carried on by De Vries and others have been cast aside as untrustworthy with the mere statement that *O. Lamarckiana* is only a garden variety or hybrid of some other form and that the new species are to be regarded as reversions to an ancestral type.

O. Lamarckiana is clearly differentiated from the other *Oenotheras*. The new species, too, are differentiated, not in one characteristic alone but in the assemblage of their characteristics.

Comparison of Old and New Species.

It is particularly fortunate that Professor De Vries was able to carry out his experiments with a plant belonging to a genus having several other species which may serve for comparison, otherwise the objection would be urged that the characters exhibited by the new forms were not of specific value. And several species of *Oenothera* have been well known for a great number of years and recognized as distinct by systematists, so that objection from

that source is silenced, for the new forms not only differ as sharply and in many points from each other as do the old accepted species, but the individuals of a given new species are always identical in their characteristics, whether originating from *O. Lamarckiana*, from one of the new species, from crossing or from the offspring of self-fertilized parents of the same species and show no transition either to other species or to the parent form.

Parallel cultivation of the recognized older species and the newly originated forms offers the best and only thoroughly satisfactory method of comparing their characteristics. De Vries was able to compare *O. muricata*, *O. biennis*, *O. suaveolens*, with two or three subspecies, *O. hirsutissima*, (*O. biennis hirsutissima* Torrey & Gray), *O. parviflora*, *O. cruciata* and a few others, while for other species his studies were limited to descriptions, figures and herbarium specimens. The result of these comparisons as stated by De Vries is that the known systematic species of the subgenus *Onagra* in the main do not differ otherwise than the group of forms originating from *O. Lamarckiana*. The groups are analogous.

Transgressive Variability, Nutrition and Selection.

In these comparisons of the characteristics or the assemblage of characteristics of the new species we must not ignore one of the strongest pillars of support of the selection theory, transgressive variability. The existence of transgressive variability has long been recognized by systematists. One has only to examine a number of individuals of two or more closely related species to find that some individuals seem to represent in some of their organs, at least, transitions between the two species.

The nature of the support which the existence of transgressive variability has been supposed to lend to the selection theory is very apparent, but its significance has doubt-

less been much overestimated. In the first place such transgressive variability is usually in respect to a single characteristic, or, if to more than one characteristic, all are not transgressive in the same way or to the same degree. Species, however, are commonly not limited by a single character but by a complex of characters. On the other hand, cultural experiments have demonstrated for a limited number of cases that seed from plants with the intermediate value does not produce plants with the measured characteristics in the same degree as the parent but those showing a strong reversion to the type of the species to which they may belong.

These general conceptions have been applied by De Vries to *Oenothera*. Two of the old and accepted species of Linnæus himself, *O. biennis* and *O. muricata*, were used for the first comparison. These differ conspicuously in the size of the flower. Measurements were made of flowers gathered without conscious selection from *O. biennis* and *O. muricata* individuals growing in the same locality. The mean length of calyx and corolla lobes for *O. biennis* was found to be 19-20 mm., while that for *O. muricata* was 14-15 mm., confirming the general impression of the difference between the two species. But the length of the calyx lobes in *O. muricata* ranged from 8-18 mm., while those from *O. biennis* exhibited a wider fluctuation of 14-33 mm. Thus the two species furnish a beautiful instance of transgressive variability, and indeed it would be quite possible to collect a series of flowers which would connect the smallest- with the largest-flowered form in an unbroken series of fluctuations. Further illustrations need not be given; they may be collected in unlimited number by anyone who chooses to take the trouble. The limits of species are transgressed but not obliterated by this fluctuating variability, which is in large measure dependent upon conditions of nutrition.

This transgressive variability is found among the new species. They show fluctuations which may be transgressive, but this is no evidence against their constancy. It is the permanence of the type which determines this.

Since we have instituted comparisons between the fluctuating variability of the old recognized species of the systematist and the newly originated species of the experimental garden, an examination of some of the experimental work on fluctuations is pertinent in this place.

What are the causes of fluctuating variations always present? It would greatly simplify matters if we might assume that the causes are purely internal, but unfortunately for the convenience of the systematist we have reason to believe that such is not the case.

Let us examine into this problem in a little greater detail. De Vries has devoted a special section in his large work to "Nutrition and Selection" and here we may point out the conclusions of the experiments performed with a view to determining the causes of fluctuating variability in the *Oenotheras*.

The length of the fruit in *Oenothera* is a variable characteristic, and the fruit of *O. Lamarckiana* at Hilversum was found in 1893 to fluctuate between 15 and 34 mm. with a mode, or greatest frequency, of 24 mm. The fruit lengths in this species are closely correlated with the vigor of the whole plant as indicated by the thickness of the stem, the longest and thickest fruits being found on plants with the largest stems.

An extensive series of experiments showed that when the plants were grown upon especially manured soil the fruit length was very greatly increased and that in fact a greater increase in respect to this character could be secured by appropriate conditions of nutrition than by the most careful selection. When the smallest fruited, and consequently the weakest, plants were selected as seed

bearers and the culture given the finest possible conditions for growth, the range of variation—the difference between the minimum and the maximum—was increased. In all these cases the curves of variation remained practically symmetrical.

Variability in the fruit-length of *Oenothera*, then, is largely dependent upon nutrition, and while it occurs in accordance with Quetelet's law of variation which has been shown to apply to the fluctuations of the measurable characteristics of so many animal and plant forms, it is also capable of experimental control. An increase or decrease in the value of a characteristic may be secured by special conditions, but the permanence of the effect is dependent upon the presence of these special conditions.

The general significance of these considerations should be apparent. Here in treating of the new species of *Oenothera* it is only necessary to call attention to the fact that these experiments show that transgressive variability cannot form an argument against the distinctness of the new forms.

Conclusions from the Several Families.

We may now review the extensive sets of experiments in general terms and formulate the conclusions which they seem to justify.

New elementary species originate suddenly and without transition. This hypothesis has been advanced for garden varieties by various writers since the time of Darwin, but, as in almost all conclusions drawn from the field of practical horticulture, the data were open to serious question. But in the work of De Vries the conditions were quite different from those generally prevailing. The number of seed plants was relatively very small and they could be studied with the greatest care throughout their entire life history, so that there could be no doubt as to

their being typical *O. Lamarckiana*. Isolation of the plants during their first generations and their more certain protection in parchment bags with self-fertilization in the later generations made it certain that hybridization, unless in a very remote ancestor, had nothing to do with the results.

All of the hundreds of individuals belonging to the seven new species described above came from carefully studied and typical *O. Lamarckiana* ancestors, sometimes under observation for several generations. Their characteristics at a very early stage of the seedling and the classification of the young plants at that period led to no inconvenience when the individuals had assumed the more numerous and distinctive characteristics of maturity. In passing judgment upon some hundreds of plants, a few would be found of a doubtful position, especially such as had developed under conditions unfavorable to the normal development, but further growth showed these to belong undoubtedly to one of the groups into which the lot had been divided, or perhaps in rarer instances to represent a form now recognized for the first time.

Sometimes there were combinations of two sets of characters, as *O. lata nanella*, *O. scintillans elliptica*. Real transition forms between the new elementary forms or between these and the parent type did not occur.

That the new species are for the most part perfectly constant from the moment of their origin has been very strikingly demonstrated for several generations of various of the newly originated forms while not a single case of reversion to the parent type can be recorded. This showed itself true regardless of the number of individuals produced; for *O. gigas*, observed but three times, as well as for such frequently occurring forms as *O. albida*, *O. rubrinervis* and *O. nanella*. *O. lata* did not permit of a decision since it was always purely pistillate and could be propa-

gated only by crossing with some other species. The two forms which were found growing wild in the potato field, and which never again appeared in the culture, were as constant as the others when fertilized with their pollen, though *O. brevistylis* is almost sterile, producing a fruit with only occasional seeds.

The exception found in *O. scintillans* has been referred to already and its theoretical significance suggested. The evidence it offers is clearly very interesting but it does not speak strongly against the assertion of the constancy of the new forms. This constancy is a most important factor in the persistence of the newly originated species and a most striking and convincing illustration is that offered by the two new forms growing wild in the field at Hilversum. Here the struggle for existence is intense. The number of plants which may mature in its limited area is only a few thousands and the number of seeds supplied by a single individual would be almost sufficient for the area if all developed. But in spite of this, *O. brevistylis* and *O. laevifolia*, probably originating as did many of the new forms of the culture in at most only a few individuals, were able to hold their own for more than twelve years!

The third conclusion is that the most newly originated types represent exactly in their characteristics elementary species and not true varieties. To many people a variety is a form demonstrably originated from another. One of the most frequent objections to the theory of the origin of species by natural selection and one which has been most used has been that the origin of species has never been the subject of direct observation. As soon as a striking example was brought forward its rank as a species was immediately denied upon the ground that it was known to have originated from some other form and therefore could not be a species. It is evident that such quibbling should have no place in scientific literature. If a species

is a really definite unit it must be carefully limited and assigned its proper name wherever met and of whatever origin. In the general acceptance of the term varieties are distinguished by a single feature while species differ in almost all of their characteristics, in habit, as it may be called.

The most closely related elementary species differ in almost all their parts. To this the newly originated species of *Oenothera* form no exception. For this reason it has been impossible to give here a description of these forms. It has been said that to adequately describe and clearly differentiate the elementary species of a region would increase the size of the local floras five to tenfold. Often these differences are such as to show themselves only to the practised eye and then only in the plants as they grow in their native habitat, the characters of habit which there distinguish them so clearly being lost when specimens are taken for the herbarium. The new species of *Oenothera* show these numerous minor differences to a striking degree. Once carefully studied and described, there is no mistaking them at almost any period of their development, for these differences, though small, are sharp and distinctive. Nor do they depend upon mere habit of growth so that they are lost when material is prepared and preserved for future study and comparison in the herbarium. In this condition, when all plants lose many distinguishing characteristics, these new forms are still to be distinguished from each other and from the parent species with perfect ease; indeed with greater ease than *O. biennis* and *O. Lamarckiana*, two old and well established species of the systematist.

Only in *O. nanella* is there to be recognized a form which in accordance with general gardening terminology might be distinguished as a variety. It is also the only one for which comparable types may be found in the other

groups. Many species of the most widely separated systematic position have similar varieties in gardens. Red and white, proliferous and double, flowers, lacinate and smooth leaves, fasciated and twisted and pendulous, and smooth or unarmed stems are a few features which distinguish many constant garden forms as varieties rather than species, and everywhere in gardening literature one will see the Latin varietal names indicating these characteristics coupled with the most widely dissimilar species. The dwarf habit is one of these characters in point and a large number of garden plants with the varietal name *nana* or *nanella* are listed.

It is very interesting that this one form is the only one appearing in the Amsterdam garden which could legitimately be distinguished as a variety rather than a species. It was the hope of the experimenter that some real varieties, as for instance a white-flowered type, would appear in his beds, but this was never realized. While *O. nanella* may be considered a variety and in accordance with systematic usage be designated as *O. Lamarckiana nanella*, it must be remembered that so far as its behavior is concerned it is as good a species as the others. Indeed its constancy was subjected to even more severe test than the rest of the new forms. From an experimental point of view no sharp distinction is to be drawn between species and varieties.

The elementary species usually appear in a significant number of individuals at the same time or in the same general period of time. In the forms studied the number may be placed at 1 to 2 per cent. of the total number of individuals—an estimate which is rather too small than too large. This is a number which has been calculated sufficient to give a species well equipped for the struggle for existence a very good chance for establishing itself.

The new forms show no marked relation to individual

variability. *O. Lamarckiana* and all the newly originated forms show the usual fluctuating variability—the new forms sometimes in a greater degree than the parent—but there is no transition. The characters of the new forms are not dependent upon the differences attained by common variability. Cultured races may be secured by selection; they are not constant, however, but dependent upon selection for their perpetuity.

In the formation of new elementary species mutations occur without definite direction; the modifications embrace all organs and occur in almost every direction. The different organs may become larger or smaller, longer or shorter, broader or narrower, rougher or smoother, or the habit of growth may tend more to annual or more to biennial than that of the parent.

The question as to whether variations are haphazard or whether they occur in definite directions has not been without its polemic literature. The theory of Darwin and especially that of Wallace explained the origin of species by the selection of purposeless variations. The mutation theory explains the origin of the larger groups of forms—the Linnæan species, but not the elementary species, by the selection of the most fit elementary species. Just as according to the theory of natural selection, many individuals do not show the fortuitous variations which fit them exactly to their environmental conditions and are forced to the wall, so according to the theory of mutation only a few of the elementary species are adapted to meet the life to which plants are subjected and the most of them must perish.

The conditions observed in *Oenothera* under experiment offer most satisfactory evidence on this point, though the real fitness of the new forms can hardly be discussed until extensive experiments have been made. The two new forms found growing in the original locality were

able to hold their own for twelve years. Some of the new forms seem, in some respects at least, to be more vigorous than the parent type; others are so similar in vigor that no differences are to be distinguished, while many are evidently at a decided disadvantage in the weakness of their seedlings, their small size, their brittleness, their partial sterility or other characteristics. It was exceedingly difficult to bring some of the new forms to maturity, and these could certainly never persist in the keen competition in which plants must participate in nature.

The seventh and last conclusion must be drawn only very tentatively since, from the nature of the case, experimental evidence is difficult to obtain. That mutability appears periodically is indicated by the fact that the number of species found in a mutable condition is exceedingly small as compared with those in an immutable state. This may stand as a conclusion until further evidence may be obtained.

C. VARIETIES IN NATURE UNDER CULTIVATION.

The degree to which the selection theory is dependent upon evidence afforded by the improvement of domestic varieties can hardly be overestimated. This has furnished almost the sole experimental basis for the promulgation of a theory otherwise resting upon comparative data. For the scientific world the theory of descent might have been generally established upon the data derived from paleontology, comparative anatomy and embryology, but the theory of natural selection could hardly have won recognition without the support derived from the attainments of breeders.

We have already discussed the soundness of these inductions in support of the theory of natural selection and have pointed out that there are very serious objections to the use of the evidence from horticultural selection which

restrict or almost nullify its significance for theoretical considerations. The words selection and improvement of the gardener's vocabulary are terms too vague to have much significance when transferred to scientific parlance. To the man of merely practical purposes, they may mean the isolation of a single desirable and constant minor species, "race," or "subspecies," from its congeners, the finding and preservation of a "single variation," the freeing of a constant race from the effects of crossing with its neighbors, the isolation of a mutation which has exhibited its latent presence by some slight external deviation, or finally, the terms may convey the meaning which is attributed to them in the generally accepted form of the selection theory, the accumulation of fluctuations. So long as the problem was the formulation of the broad outlines of the theory of descent it was not necessary to look into this evidence more critically, but we have reached the stage in which this can no longer be neglected.

The beautiful observations of Professor De Vries upon the evening primrose have shown that species differentiated in the totality of their characters may originate immediately from others. To some it may seem that the evidence afforded is so complete and satisfactory that recourse need not be had to the evidence offered by garden varieties. But an examination of trustworthy observations reveals the fact that when investigated in a systematic way, and with the precautions which should be a condition of all scientific experiment, garden varieties yield data of the highest value.

What are varieties? This query has been answered no more satisfactorily than the great question of systematists, "What are species?" The affirmation that varieties are incipient species has not cleared away the difficulties of the systematist, and in the absence of any generally

accepted code each has used his own pleasure in designating the forms he described as species or varieties.

Linnaeus seems to have recognized two kinds of varieties, and the practice of many of the best systematists lends weight to this conception. There are the numerous constant and well-defined minor forms or subspecies, "the elements of the species," as De Candolle termed them, and there are the derived forms. In the first case a number of types are grouped together for the sake of convenience but with the tacit understanding that all are of equal rank and that no one can be considered as derived from another; there is no *forma typica* from which others may be supposed to have originated by minor modifications.

The second class of varieties differs essentially from the first. While their origin is generally involved in as much obscurity as that of the minor species, there is strong comparative and physiological and even historical evidence that they are derived from a known specific form. Varieties of this class are generally distinguished by a single characteristic although others are not infrequently, perhaps generally, associated with it.

The first point of evidence for their derivative nature is the frequency of their occurrence in widely different genera and families. Smooth varieties of hairy species, thornless varieties of armed species, white forms of red and blue flowered species are known to every one at all familiar with plants. These we may designate as true varieties; they differ from the typical species only in the stronger or weaker development of some special character or in its entire disappearance.

Varieties present certain advantages for investigation. Only a few members of our flora seem to be in a mutable condition in which new species are produced; the birth of a variety is probably a more common occurrence. Furthermore, according to quite generally accepted rules, a variety

is distinguished by a single characteristic and their study is largely the investigation of the nature and conduct of individual characteristics.

The mutation theory is not merely concerned with the observation of the origin of species or varieties and with the demonstration that there is an unmediated rather than a gradual process; it attempts to go farther and analyze the characters of species and reduce them to the component units or elements. Differing from their species in only a single character, varieties offer most favorable material for the study of the individual units.

The Constancy of Varieties.

It is quite generally assumed that varieties differ from species in their inconstancy and it behooves us first of all to look into the evidence upon which such an assumption is based.

Many "varieties" are only the parts of a single individual found as a "sport" by some horticulturist and propagated by cuttings or some other vegetative method. Such forms are often inconstant from seed and are in no small degree responsible for impressions of the inconstant nature of garden varieties. A similar source of confusion is hybrids propagated in a vegetative manner. The many thousands of plants are perfectly constant so long as they are only parts of the same vegetative body divided and grown separately, but when propagation by seed is attempted the variety is lost. Gardeners know full well the importance of these vegetatively propagated hybrids and some of the greatest successes of Luther Burbank and others are of just this kind. Another source of confusion is the improved races which are merely the accumulation of fluctuations by selection and so soon as selection ceases the betterment is lost and the "variety" reverts to the species.

Such ameliorated races or vegetative varieties are

often not to be distinguished from true and constant varieties by inspection, and their designation by the same term necessarily results in confusion and strengthens the impression of the inconstancy of "varieties" as compared with "species." The same is true of partial variability. Parts of the same individual grown on mountains may differ so widely from the part cultivated in the lowland as to deceive all but the one who knows the whole history; the experimental morphologist in his laboratory may cause the different parts of a single plant to assume strikingly different forms by controlling the conditions of light and moisture, but while these experiments bring serious misgivings as to the validity of many of the species catalogued in the floras they do not establish the inconstancy of species.

Accidental crossing is one of the greatest sources of error. The experiments which have been made upon this point need not be given space here, but the danger from this source cannot be too strongly emphasized.

Pollen may be carried by insects or wind for long distances and except with the greatest precautions one can not be confident that the packet of seed which he collects from his plants for his next year's crop has not a few which contain blood of another sort. In the case of varieties the danger is still greater. In the crossing of species the hybrid usually has a form intermediate between that of the two parent species, but seeds produced by fertilizing a variety with pollen from its species or *vice versa* produce plants which cannot be distinguished from the species. The character of the variety is there in a latent condition and it will make its appearance later.

The establishment of so many sources of error in the evidence for the inconstancy of varieties suggests that after all these forms may be constant. We cannot attempt to discuss the numerous cultural experiments which have

been performed by De Vries, Hildebrand, Hoffmann, Hofmeister, and others to test the constancy of varieties. When crossing with other types was prevented constancy was found almost without exception. Among thousands of seedlings of varieties differing in the characteristics of their floral structure or color, in smoothness or hairiness, in the armature of stems or fruits, in the forms of their leaves or the habit of the stem, no reversions to the parent form have been found. These experiments, and their number and extent is very great, evidence most forcibly against the assumed instability of these minor forms.

One of the most important proofs of the constancy of spontaneous or garden varieties is the great age of some of them. New forms are introduced every year, but it must be remembered that they are produced in a great number of ways and that their designation as varieties is merely a matter of convenience not always to be justified on scientific grounds. Many varieties were known to the Greeks and Romans, and when we come down to the more modern times of the herbals of the sixteenth and seventeenth centuries we find excellent illustrations of some which we have to-day.

The Origin of Garden Varieties.

If, then, garden varieties are constant, what has been the mode of their origin? The evidence derived from the experiments with the evening primrose leads us to consider it most probable that their appearance has been by mutation, by sudden steps or bounds, and not by a gradual process of selection.

Historical records upon these questions are not very satisfactory, but a searching examination of such as exists tends to emphasize the probability of a sudden origin of the constant garden forms.

The instructive history of *Chelidonium majus* lacini-

tum has already been mentioned. First observed in an apothecary garden in 1590 and never found in a wild state, it is to be assumed that this cut-leaved variety originated by mutation from the ordinary form and that it has been constant to this day. Of cut-leaved varieties among trees a long list might be given. Laciniated alders seems to have been produced by mutation at sundry times and cut-leaved maples are said to be produced quite frequently from seed of normal trees.

For many horticultural purposes, "weeping" varieties of trees are prized and a number of species have these varieties. They seem to have originated suddenly in single or at least very few individuals.

The smooth-fruited variety of the thorn-apple, *Datura*, originated suddenly and is of particular interest from the fact that it furnished the data for one of the earliest and clearest statements of the idea of mutation. Other cases of the origin of thornless varieties by mutation are well authenticated or highly probable.

The dwarf variety of *Tagetes signata* originated in a single individual among others of the normal form in Vilmorin's nursery in 1860. The dwarf *Oenothera*, *O. nanella*, may be recalled here and several other cases of the sudden appearance of constant dwarf varieties might be mentioned.

The remarkable origin of the cactus dahlia has already been described, and numerous other cases might be given were space available. As already stated, the accumulated evidence indicates for garden varieties a sudden rather than a gradual origin and justifies citing them as evidence in favor of the mutation theory. Sterile varieties are not easily explained on the ground of the selection theory, but they lend themselves most readily to the support of the mutation theory. Korschinsky has done a most important work in examining carefully into the history of garden

varieties for the purpose of determining the mode of origin of the various forms. His review is most comprehensive, covering the most diverse characteristics of stem and leaf and flower, and he concludes that the origin of new constant types has been by unmediated steps, by what we now term mutation, and not by the accumulation of fluctuations.

The history of some of these cases is most interesting, but these very general statements must suffice for the comparative data while we pass to the consideration of two sets of detailed and laborious experiments. The first is the origin of the "double" variety of the corn-flower and the second peloric form of the toad-flax.

Origin of the Double Corn-Flower.

Of all garden varieties perhaps the most common are the so-called double or filled flowers. Roses, hollyhocks, carnations and larkspurs are at once called to mind and the preparation of a complete list would be a serious task. This doubling usually consists in the transformation of stamens, and sometimes carpels as well, into petaloid structures.

Among composite plants, the sunflowers, daisies, marigolds, zinnias and others, we also meet with double varieties. Here the flowers are an aggregation of small flowers or florets. Of these, the outer row are frequently provided with large, conspicuous, strap-shaped or ligulate corolla and are designated as the ray flowers, while the others in the center of the disk have a short, tubular corolla usually of relatively inconspicuous color as compared with the showy peripheral ones, and are known as disk or tubular flowers. Occasionally only tubular or "disk" flowers are present, as in Eupatorium and thistles, and again only ligulate flowers, as in the dandelion. Many forms originally with both disk and ray flowers have become "double"

by the transformation of the tubular corollas of many of the disk flowers into the ligulate corollas characteristic of the periphery. The most familiar examples of this are the *Chrysanthemum*, *Zinnia* and *Dahlia*.

With the hope of observing the production of a flower of this type from the normal form, De Vries cast about for a suitable species upon which to work, and finally chose the corn-marigold, *Chrysanthemum segetum*, which has a much prized garden variety *grandiflorum*.

Upon counting the ray flowers of the terminal heads of the plants grown from the seed which he secured from botanical gardens, indications of a mixture of the varieties were seen. The number of ray florets in the *Compositæ* is variable. This variability follows the law of Quetelet, and this variety *grandiflorum* is distinguished by the possession of twenty-one ray flowers whereas the species has thirteen; around these numbers the fluctuations occur, the typical form sometimes bearing more than twenty-one rays and the *grandiflorum* type sometimes as few as thirteen.

The mixture was easily sorted into two constituent varieties by the selection of plants with thirteen- and twenty-one-rayed flowers. This process, however, requires much time since thirteen and twenty-one are only the typical worths around which the plants vary, and it is quite possible that a plant which is spared may be a widely fluctuating individual of the other type.

After three years' selection of twelve- and thirteen-rayed plants over 150 individuals were counted and found to have an average of exactly thirteen rays in the terminal head. The following year the same figures were obtained, so it was evident that the pure thirteen-rayed type had been isolated. The *grandiflorum* type was now isolated in the same way, the rays of the terminal heads of over

1500 plants being counted in the last year of the process of isolation.

In 1896 De Vries selected 500 plants from the 1500 with terminal heads with twenty-one rays and about the middle of August counted the rays of all the heads of the secondary branches as well. Among the many thousands of heads examined, all but two had twenty-one rays or less. This single exceptional plant was isolated and the heads allowed to be fertilized by pollen carried by insects from some others of the best plants of the group.

This slight deviation of structure in the secondary branches of this individual seemed indicative of some more profound change, for the number of rays could now be increased rapidly by selection. The progress was by veritable leaps. In the first year the average came up from 21 to 34, and then to 48 and 66 in the two succeeding generations.

These changes, however important, do not represent the real object of the experiment, which was to observe, if possible, the real origin of a double from a single form, —that is to say, a form in which some of the tubular flowers of the disk were transformed into ligulate or strap-shaped flowers similar to the rays.

Finally, in the fall of 1899, the fourth year of the selected race, the desired anomaly made its appearance in a single individual in which a few rays were found in the disks of three of the younger heads on one plant.

Two years' work eliminated the effect of crossing with other individuals and the double variety was quite as perfect as the other cultivated types of the same kind.

Origin of Peloric Toad-Flax.

By peloria we understand the assumption of an actinomorphic or regular form by a normally zygomorphic or irregular flower. Presumably the prototypes of these ir-

regular flowers were themselves regular so that in a certain sense the assumption of the radially symmetrical form may be regarded as a reversion to a more primitive type.

This anomaly is described for a large number of forms, especially the two-lipped Labiatæ, Scrophulariaceæ and Gesneriaceæ. A discussion of the structure and manner of occurrence of these forms would be of great interest, but here we must limit ourselves to the most condensed treatment possible.

A gradual origin of such a deviation as peloria is not easily imagined. The phenomenon is seen very rarely or not at all in some genera or families while in others it may be observed with great frequency. Indeed examples of peloric races are not unknown. Seeds from such a one may be obtained for the foxglove and snap-dragon, *Digitalis* and *Antirrhinum*, which repeat the anomaly with great regularity though not always in all flowers or individuals. Another very constant example is the *Gloxinia* of our greenhouses. These showy plants have an erect, splendidly colored regular corolla while that of the prototype was more or less pendent and irregular.

Usually only a few of the flowers of any one plant are peloric, but in the toad-flax, *Linaria vulgaris*, all the flowers of a plant sometimes show this peculiarity. The corolla of *Linaria* is normally two-lipped and one-spurred, but in the peloric forms the two-lipped character disappears and the number of spurs is increased to five.

De Vries chose this species for experimentation because there was evidence that the wholly peloric variety had originated from the normal type with only occasionally a peloric flower in a number of instances and in widely separated localities. This renders it probable that it may appear again and under carefully controlled conditions of ancestry and environment. The object of the culture

was only to observe again what has presumably occurred in nature at various times.

The first recorded discovery of peloric toad-flax seems to be that of a student of Linnæus, whose find was described in 1744. Since that time it has been discovered in many places and under circumstances which render it most probable that it originated upon the spot from the normal type. In some cases the variety seems to have flourished for a time only to disappear later. The assumption of an independent origin of the peloric variety in each locality is supported by the fact that it is very difficult of fertilization by insects and ripe capsules with seeds have never been seen in nature, a fact which discredits at once the assumption of a possible common origin of the collections from the many widely separated localities.

In 1886 De Vries began a series of pedigree cultures of *Linaria* in the hope of being able to observe the origin of the peloric form. Roots of normal plants with one or two peloric flowers were transferred from a locality near Hilversum to his garden and flowered the following summer, producing seed for the second generation which was grown during the three following years. The plants flowered profusely, bearing in 1889 only one and in 1890 only two peloric flowers. Seed from the flowers of 1889 served for the continuation of the race, the third generation in 1890-91, which produced thousands of normal flowers but only a single five-spurred flower, which was pollinated by hand and produced ample seed for the culture of 1892. By sowing in the greenhouse and suitable methods of culture it was found possible to raise this and subsequent generations as annuals. Again only a single peloric flower was observed. The plant bearing this and one other individual were selected as seed parents—the toad-flax being quite sterile with its own pollen—and yielded an abundance of seed.

From this seed about fifty plants flowered in the autumn of 1894. Among these several peloric flowers were observed, eleven plants showing either one or two or even three of these abnormal flowers, but this cannot be regarded as remarkable since such individuals may occur in varying, though usually small, numbers in each generation. A single plant, however, was observed to produce only peloric flowers; the following year it bloomed again and confirmed the conclusions of the first year; the flowers were peloric without exception. Here, then, in a plant whose ancestry was definitely known to be of normal type for four generations, we have the first experimental mutation of a normal into a peloric race occurring suddenly and without transitions, only a single peloric flower having been found in the careful daily scrutiny of the thousands of flowers produced by the parents during two summers.

The ten cc. of seed from which the sowing for the fifty plants had been made was now nearly all sown and some 1750 flowering plants secured among which 16 wholly peloric individuals were found. The mutation occurs, therefore, in about 1 per cent. of the individuals. The possibility of crossing with the mutated individuals was excluded and the experiment continued. In subsequent generations the mutation was again repeated but with cultures limited in extent. In one case, however, two and in another one mutated individuals were obtained. These were related as "nieces" to those described above and appeared in the same manner, suddenly, completely formed and unaccompanied by transition to the normal form.

The external features of a plant must not serve as an ultimate criterion for the determination of its place in the system of classification. So far as may be seen by the eye alone it is often impossible to distinguish between an inconstant ameliorated race, a hybrid or an extreme

variation propagated by vegetative means, and a true ~~spe~~cies or variety. The true criterion of systematic worth ~~is~~ constancy in heredity and this is the test which must ~~be~~ applied to all mutations.

In the case of the toad-flax under consideration ~~this~~ is extremely difficult owing to the almost total sterility of the race cultivated. From over 1000 flowers carefully pollinated not a single normal fruit was secured but a rudimentary capsule yielded seed for 119 flowering plants of which about 90 per cent. were true to their type. Whether the ten per cent. reversion was due to atavism or only to accidental crossing cannot be determined.

Summarizing these remarks on peloric forms we ~~find~~ that peloria, the assumption of a more or less regular form by a normally irregular flower, is not infrequently observed in nature, and in some families with much greater frequency than in others. In some cases it seems to be ~~in~~ a high degree heritable so that we may perhaps speak of peloric races. In other cases the phenomenon does ~~not~~ appear in every generation, but the latent potency which we may assume to be at the base of it becomes only occasionally active and we have what we may term iterative mutation. In the case of the toad-flax, De Vries has observed the origin by mutation of a perfectly formed peloric variety, *Linaria vulgaris peloria*.

D. CONCLUDING REMARKS.

The conclusion which impresses itself upon the mind of the reader as he lays aside the first volume of Professor De Vries's work is that the origin of species has, in a few cases at least, become a matter of direct observation. This important process is no longer beyond the limit of actual observation and supported by only comparative data.

This is the point upon which the author himself lays the greatest emphasis and to a discussion of the method

of experimental evolution he devotes considerable space. For our present treatment it will be well to pass over these more special considerations and mention briefly the general conclusions derived from a comparison of the theories of selection and mutation.

No two individuals of a planting are exactly alike, expresses the variability—flowing, fluctuating, individual, statistical or whatever else it may be termed—of all living things. The selection theory postulates that these individual variations may be accumulated and fixed by selection. The mutation theory regards them as of no significance for the origin of species. Garden or local races may be developed or improved or acclimatization secured, but the limits of specific identity are not transgressed. The modifications accumulated by selection are not unlimited in extent and do not become independent of selection for their perpetuity. In sharp contrast to this betterment of forms by selection is the origin of new types. These appear suddenly, without transition from the parent type, and are constant from the first.

The statement that species have originated through natural selection in the struggle for existence requires some explanation before it may be embodied in the mutation theory. When the struggle for existence, or better the competition for existence, occurs between individuals of the same species, those least fitted to meet their life-conditions are forced to the wall and improved races or acclimatization results. This falls within the field of common variability. The competition may also occur between individuals of different species and then the *species* best adapted to the environment persists. But the struggle for existence and the survival of the fittest has nothing to do with the origin of the fittest. Before they may come into competition species as individuals must exist, and it is with special *species-forming* variability that the muta-

tion theory is concerned. The "survival of the fittest" has, then, two distinct meanings, the survival of the fittest individuals and the consequent development of local race or the securing of acclimatization in the constant specific type and the essentially different survival of the fittest species.

According to the mutation theory species have originated not by slow selection continued for hundreds or thousands of years, but by steps, through sudden though often very small transformations. Variations occur in plus or minus directions while mutations occur irregularly in all directions. Variations are of constant occurrence but mutations appear only from time to time.

The theoretical importance of the results of this long and laborious series of experiments carried out by Professor De Vries can hardly be overestimated. It is difficult for contemporaries to evaluate justly the interpretations which a naturalist assigns to the facts he has discovered and compiled. Many refuse to accept De Vries' positive iteration of the essential difference between fluctuating variability and mutation and the impossibility of accumulating the former by selection to the amount of fixed specific differences, but the results of the observations can hardly be discredited, and those who are acquainted with the literature of botany see everywhere series of other facts which seem to become clear and significant in the light of De Vries' discoveries and interpretations. It is not desired that these pages be a contribution to the too voluminous polemic literature of evolution, but that they shall furnish an epitome of the attempts and achievements of those who have been convinced of the discontinuity of variation with the consequent discontinuity of specific characters. It need only be remarked further that the researches of De Vries and others have built up a system of data which is impregnable to all but similar or improved

experimental methods. These investigations have raised the study of evolution from the morass of polemics, and in connection with the rediscovery and investigation of the Mendelian principles have given us the hope of the attainment of a real and definite knowledge of the organization of species.

Whatever be the present view of the generalizations which have been drawn, no one can deny the value of the method. Professor De Vries himself says: "Hauptsache ist, dass die Culturen im Garten uns verrathen, was in der freien Natur stattfindet, was sich dort aber der Beobachtung entzieht."

But while insisting on the fundamental value of the method, we must not lose sight of the intrinsic value of the materials assembled by De Vries in support of his theory. "The greatest contribution since that of Darwin," is the estimate of even those who are conservative in accepting the generalizations which De Vries has formulated. It is not given to one man to elaborate and promulgate alone an epoch-making doctrine, and several writers have perceived the importance of many of the conceptions which find their place in the comprehensive theory as it is now elaborated; but it is the fundamental importance of the results of long years of patient and successful experimentation which has won for Hugo De Vries the first place among those who have contributed to the renaissance of evolutionary studies.

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FRANCE.

THREE RECENT WORKS ON CHRISTIAN THOUGHT AND CATHOLICISM.*

I DESIRE to include in one group three works,¹ the subjects of which are closely related and supplement each other. These

¹ Paris: Librairie F. Alcan.

are *La Pensée chrétienne* (from the Gospels to the *Imitation of Christ*) by Joseph Fabre; *Histoire générale et comparée des philosophies médiévales* by François Picavet; and *L'Evolution de la foi catholique* by Marcel Hébert.

M. Fabre's work consists of six parts. The first two, "Jewish Eclecticism," and "Alexandrian Eclecticism" give a synopsis of the philosophies which prepared or inspired Christianity. The third and fourth books, "Primitive Christianity" and "Catholic Dogmatism," show the origin, the formation (and also the deformation) of dogmas, sacraments, and rites up to the point where we find them in the Catholicism of to-day—a very interesting part of the volume. The fifth book, "The Scholastics," explains the beginning of the medieval schools. The sixth, "The Mystics," presents contemplative spirits side by side with dialecticians; the ecclesiastical and dogmatic religion as opposed to religion of sentiment, which may be considered a religion active or passive according to the evangelical current whence it proceeds.

Though M. Fabre's fine volume contains no less than 656 pages.

* Translated by Amélie Sérafon.

the exposition is brief. It would not have been possible at one attempt to exhaust so vast a subject and the author has intended rather to give a summary review of Christian thought, from its commencement to the end of the theological era. Though he has proved himself fully qualified for the task, it will be advisable to supplement his work, either with M. Marcel Hébert's critique of Catholic dogmatism or M. Picavet's history and interpretation of mediæval philosophy.

* * *

M. Picavet's work of 367 pages(very fine print) is indeed a monument. So broad and so exact is his scholarship, and so clear his method of exposition, that this work will remain an indispensable guide, not only for the study of the schools in the Middle Ages, but also for the entire history of those times.

In this work he has undertaken to compare the history of philosophy with all forms of the history of civilization and to make a still deeper comparison between philosophies and doctrines in relation to each other, especially of those philosophies and theologies in the Middle Ages which had a common inspiration, and never ceased to exert an influence upon one another. It is interesting to read in his first chapter the details of his plan for study which he himself applies in the present work as far as possible, though this is only the outline of an extensive history that he means to write.—This sketch, however, as I have said before, is already a work of the first rank.

Let us show at once the results obtained, without stopping to expound the method. The most important of these results has been the consideration, at last, of the mediæval philosophies in their completeness, and the exact definition of their common characteristics, their origins and tributaries. Henceforth it will no longer be possible to reduce them to what was formerly called scholasticism, that is to say to a "philosophy that was Christian, Catholic, orthodox, more or less confused with Thomism, and closely allied to peripatetic logic." Still less would it be possible to limit them to the

question of "universals," a question, let us add, whose range and significance have been demonstrated in modern debates on evolutionary theories. It seems, on the contrary, that these philosophies form "a collection of theological philosophies, which are connected with Hellenic and Roman religions, with Judaism, Mohammedanism, and Christianity." All, or nearly all, give way to antique systems and to acquisitions of positive science in their own time.

The Aristotle who became one of the masters of the Middle Ages, M. Picavet affirms, was not the intellectual Aristotle, the logician and disciple of Plato; nor even the Aristotle of whose writings St. Thomas furnished a commentary from authentic texts; but it was an Aristotle who was the bearer of doctrines associated with his philosophy by successive generations of speculators; an Aristotle deformed at the hands of Stoics and Epicureans (and above all of the Alexandrians) who handed over his philosophy thus disfigured to the Arabs, Byzantines, and Jews, by whom it was again transmitted, imbued with mystical and religious characteristics, to the mediæval philosophers from the eighth to the eleventh centuries. Moreover—and this fact is of no small importance—the thought of the Middle Ages is not connected directly either with Aristotle or Plato, nor with St. Paul, nor with the Hellenic Jew, Philo. The first and truest inspiration came from Plotinus.

M. Picavet establishes with forcible proofs that all syntheses first attempted between scientific, theological, and philosophical elements can be traced to Plotinus, and also those undertaken later by the Christians, Mussulmans, Oriental and Occidental Jews. This fact helps to explain why the principal trait of mediæval philosophies was, above all, reflection on the subject of religion and various aids to faith. Speculations about God and the soul, and the means of becoming united to divine perfection predominated; so that the thought of the mystics no longer appeared as an exception to the abstract and logical manner of thinking of schools, but rather as one of the purest manifestations of that religious spirit which is in some degree to be found everywhere.

Plotinus's system (which, M. Picavet says, far surpasses the

tion of faith and condemned "fideism":
 tions round which the development and
 are grouped.

sentiment has a tendency to explain and
 to account for the fact that religions
 transition from religious feeling, image,
 by sentiment alone,—the transition from
 more or less philosophical interpretation, and
 of theories—in this progression (as far as
 lies the scheme of theological evolution.
 this transformation to be found in the Bible,
 Gospel. In this, Jewish intelligence gives way
 the notion of the *logos* is purely Greek.

meanings of the word "faith" correspond to the
 —Faith in the Old and New Testaments means
 Epistle to the Hebrews, certitude of the invisible;
 Fourth Gospel, it is an element of mystical union.
 Epistles a new meaning appears: the direct inter-
 and the soul gives way to the relation between
 ecclesiastical authority. The crystallization of
 to operate. Thenceforth the more personal, the
 of faith is called "piety"; and the meaning "in-
 " or "orthodox belief" becomes more and more the
 of the word "faith." Reasons for this are not
 the longing of the distressed soul for an intangible
 dogma, entrusted to an infallible authority, and "such
 an authority must as a matter of course have arisen
 enthusiastic Christian atmosphere where lack of a critical
 always the general rule and where simplicity of mind
 to be a virtue." Next, the heresies and ravings of the
 in which the moral efficacy of Christianity vanished, de-
 the formation of monarchical episcopacy and orthodoxy.

arise two orders of facts or questions which mingle in an
 account—but which ought to be distinguished from one
 order to make things clear. One is the question in regard

M. Hannequin² reproaches M. Picavet with seeing perpetuated of the scholastics in the metaphysicians of the seventeenth century, in Descartes and even in the scholars and psychologists of the present period, without observing that the universal familiarity with mathematics has changed the point of view. This reproach seems unjustified to me. Certain problems are not necessarily done away with because their text has been modified, and the continuity of effort consists in different processes of solution. But I do not wish to engage in this debate; scarcely have I been able to give an adequate idea of the riches of this volume, the mere index to which constitutes a real compendium.³

* * *

M. Marcel Hébert (formerly l'abbé Hébert) has undertaken the task of investigating the formation of Catholic faith and the problem of the survival of Catholic organization. He wishes to take neither the attitude of revolt nor that of submission. Revolt, he says, is unjust and passionate. Submission exposes to unconquerable difficulties whoever does not freely accept the authority of the Church as supernatural, and the "transcendence" of Catholicism: it is impossible to see anything else in l'abbé Loisy's submission, for instance, but an "opportunistic disciplinary solution," a "provisional transaction."

It can not be disputed that a certain sentimental disposition, a peculiar attitude of heart and mind has led men at all times to create religions. The fact is incontestable, and only the historical consequences are of any importance to us here, without defining exactly or criticising more closely the different situations or significations which we can give to the term "religious feeling." We shall see a little further on how M. Marcel Hébert himself defines it.

Why religious feeling has expressed itself in the form of theology; how this transformation occurred and how we have passed from individual faith to ecclesiastical faith; how the Council of the

² *Revue Philosophique*, April, 1905.

³ To curious readers interested in the Catholic movement I would especially suggest the chapter before the last "La Restauration Thomiste au XIX^e siècle."

Vatican regulated the question of faith and condemned "fideism": these are the principal questions round which the development and discussions of his work are grouped.

The law that every sentiment has a tendency to explain and express itself, is sufficient to account for the fact that religions have originated. The transition from religious feeling, image, and myth, interpreted by sentiment alone,—the transition from image to theory by a more or less philosophical interpretation, and then the systematization of theories—in this progression (as far as relates to Christianity) lies the scheme of theological evolution. There is no trace of this transformation to be found in the Bible, except in St. John's Gospel. In this, Jewish intelligence gives way to Grecian intelligence; the notion of the *logos* is purely Greek.

The different meanings of the word "faith" correspond to the growth of theology.—Faith in the Old and New Testaments means trustfulness; in the Epistle to the Hebrews, certitude of the invisible; in St. Paul and the Fourth Gospel, it is an element of mystical union. In the Pastoral Epistles a new meaning appears: the direct intercourse between God and the soul gives way to the relation between "the faithful" and ecclesiastical authority. The crystallization of beliefs is beginning to operate. Thenceforth the more personal, the more intimate side of faith is called "piety"; and the meaning "intellectual belief," or "orthodox belief" becomes more and more the only actual meaning of the word "faith." Reasons for this are not wanting. First, the longing of the distressed soul for an intangible and stable dogma, entrusted to an infallible authority, and "such dogmas, such an authority must as a matter of course have arisen in that enthusiastic Christian atmosphere where lack of a critical spirit was always the general rule and where simplicity of mind was held to be a virtue." Next, the heresies and ravings of the Gnostics in which the moral efficacy of Christianity vanished, determined the formation of monarchical episcopacy and orthodoxy.

Here arise two orders of facts or questions which mingle in an historical account—but which ought to be distinguished from one another in order to make things clear. One is the question in regard

er to demonstrate the truth of the dogmas, in justifying and explaining their contents. And the Church after all "was right not to permit man to limit himself to one of his faculties"; she has tried to keep the middle course between "the pure intellectualism of a Comte or a Gunther, and the pure sentimentalism of a Schleiermacher." Against "fideism" she accepts and defends intelligence; she does not consent to be satisfied with a *practical truth* or a *symbolic value* instead of dogmas; she has claimed and still claims for herself a *theoretical truth* and an *objective value*."

But how is it possible to prevent reason from taking more than is warranted it? M. Hébert shows us Catholic dogma held tightly between the two jaws of a vise, philosophical thought and historical criticism. He does not think its essence will issue from it purer and more active. The conception of symbolism of the dogmas, as presented by Auguste Sabatier in the Protestant Church and Alois Loisy in the Catholic Church, appears to him illusory. They are in these dogmas only constructions of faith, of creative imagination, symbolizing our feelings and aspirations, which Rome could not accept without destroying itself. The Church claims for itself supernatural authority, but not in the philosophical sense (superfensible). The Catholic notion of the supernatural is that of a *person*, an energy, a gift, bestowed by God, that no finite being could acquire by his own strength. The Church believes in a supernatural which is essentially distinct from the natural; it does not submit to be reduced to the level of a simple providential institution. The symbolistic interpretation, therefore, (symbolistic Catholicism, liberal Protestantism, liberal Judaism) is an expedient, not a solution.

Loisy's works represent, according to M. Hébert, the historical movement of the present movement, which he calls the "renaissance of symbolism." Blondel represents its philosophical form, Brunetière its historical form. To Brunetière Hébert raises the objection that the longing for belief does not imply the constitution of an authority to determine the belief; Brunetière brings forth anew the theory of the "moderate traditionalists." Far greater he judges the importance

of Blondel and Loisy. Blondel, moreover, attempts in vain to pass from the human natural to the Christian supernatural; and Loisy, to realize "free faith in free history." Their "fideism" only saves the right of a religious consciousness to assert itself by myths in which it might express and incarnate itself.

Ecclesiastical authority "is wrecked by the historical investigation of miracles, particularly of the resurrection and of the transmission of Divine powers from Christ to the Church."

And now the author of this remarkable work concludes, "it is because humanity had embodied the highest aspirations of conscience in Christian dogmas, that these myths affected it more by a deep moral suggestiveness than by the force of their literal meaning—since criticism demonstrates their worthlessness." "The great progress achieved in our days," he continues, "is that religious feeling itself is no longer confused with the monotheistic myth in which it was formerly embodied." This deep sentiment cannot be wrecked.—But henceforth there can be no religious act except the conscious adhesion to that ideal order of things to which science, art, and morality tend." "It is precisely in so much as we feel in science, art, and morality, the knowledge and progressive realization of that ideal order, that we find a religion there. That impulse is religious, and that alone, by which we act as organs of that wonderful creation of a better order of things."

* * *

Besides the special interest of the subjects treated, the three works I mention, written by men who have not the slightest resemblance to each other, will impress the readers of *The Monist* pretty accurately as to what the attitude is in France towards Catholicism, the attitude of thinkers entirely freed from Church authority, but holding in regard to the religious interests of societies, lofty and correct ideas, far removed, in this, from the unwholesome passions, which too easily predominate in our political assemblies.

Although indifference in religious matters is of common occurrence among us, all religious activity is far from being extinct. Both Catholics and Protestants possess important reviews and jour-

nals; numerous works are produced by the pen of Churchmen and sincere believers. A singular fact might perhaps be mentioned, that in some Catholics faith in dogmas vanishes without their zeal for the religion of their fathers being in the least diminished. Besides these publications I could name several practical associations for propaganda, the *Sillon* (furrow) for instance, founded by M. Marc Sangnier. And the open hostility of our newly elected rulers has not been able to impede the movement; on the contrary, it has taken greater force. The separation of Church from State might diminish the apparent power of the Church, but it would increase its real vigor and might at least determine the formation of a Catholic party which would be energetic and of considerable numbers.

Freedom of thought is a fine condition. But how few men deserve the title of free thinkers! How few are capable of thinking, or really ever think for themselves! The ruin of present religious associations (if it could be brought about) would leave room for associations of another sort, and the same individuals would soon give themselves up to other disciplines. There will always be, in the human flock, many sheep to one bellwether. But is it really so great an evil? Is it not rather one of the essential conditions of social life? True statesmen and philosophers cannot ignore these simple truths, which escape the blurred vision of partisans. Vainly these latter imagine, after the fashion of children, that they are deceiving time by changing the hands of the watch and flatter themselves that they can complete history within the course of their own short existence.

I approve, too, the position of our eminent Editor Dr. Paul Carus in making a few prudent reservations concerning M. Yves Guyot's letter published in the June number of *The Open Court*. I would myself like to offer several observations on certain points in that letter, but they would lead me too far from the particular object of our correspondence, and as it is, I owe an apology for adding a long page to an already extensive analysis.

PARIS, FRANCE.

LUCIEN ARRÉAT.

CRITICISMS AND DISCUSSIONS.

THE PROBLEM OF TIME.

PHYSICS VS. METAPHYSICS.

The great St. Augustine, Bishop of Hippo, in Africa, and theologian, the celebrated French prelate and writer, Fontenelle, and Kant, greatest of German metaphysicians, all believe time is stationary; that it does not, with relation to the transit of matter, begin, pass, and end with relation to events. Respecting this subject, in Latin, French, and German, they bequeath to us their lucubrations. St. Augustine at one time so puzzled and distressed about the mystery, as he deemed it, that he besought heavenly enlightenment.

But let us take a simple case, as illustrative of the point established in the course of the demonstration here intended. On the contrary, time is not stationary, that it passes with the transitoriness of other things.

For the convenience of round numbers, let us imagine a locomotive in motion, aboard the train of which a passenger is seated. Let it go a mile, at the rate of sixty miles an hour, a mile a second, or exactly eighty-eight feet a second. Let the locomotive's whistle blow a continuous blast during the minute passed while it is traveled. The passenger perceives the sound to be of the same pitch throughout the whole distance. But let him, on the contrary, stand beside the railway while a locomotive rushes by under the same conditions of speed and sound. He no longer perceives the pitch of the whistle to be the same throughout the course of a mile. He hears its pitch, when the whistle is near him, as a shrill or yell, but as it continues to sound, with the rapidly departing train, he hears it successively as a roar, a groan, and a moan. The distance, comes silence.

The pitch of every note, natural or artificial, depending upon the greater or smaller numbers of vibrations acting on the drum of the ear, the greater the number of vibrations produced by a resonant body is, the higher the pitch of the resultant note; the smaller the number, the lower the pitch. The highest pitch perceptible by the human ear is of 38,000 vibrations, the lowest, only 16. The listener standing near the locomotive, under the circumstances described, hears, as has been mentioned, the same note, first as a shriek or yell, then as a roar and a moan, its natural pitch affected by time and distance, lowering it in effect, to the listener's ear until silenced by distance. This happens because, as the whistle rapidly increases its distance from the listener, the vibrations are spread out, so to speak, through the effect of lapsing time over increasing distance. The velocity of sound, unlike that of light, which is instantaneous for all but celestial distances, requiring considerable time to reach a given point (a second,—temperature 60.8° Fahrenheit,—for every 115.4 + feet), and the whistle's rate of departure from the listener at the railway's side being eighty-eight feet per second, only a portion of the normal vibrations per second of its pitch reach his ear, and these, in consequence, represent lower notes.

This is the fact, open to the observation of the least acute observer, and such as it has often been scientifically described. Being the fact, it completely disproves the theory that time is stationary, and that only matter and events, as the general condition of other phenomena, are fleeting. Assume, however, for the sake of argument, that time is stationary, and we shall clearly perceive, by comparing a consequence of that theory with the conclusion just reached, how ill it stands the test.

Time, then, we will concede, for the sake of argument, is stationary. If it be so, then, as before, the passenger aboard of the opposititious railway train going one mile a minute, eighty-eight feet a second, while its locomotive blows a continuous blast from its whistle, hears the true pitch of the whistle from the beginning to the end of the prescribed mile. This, therefore, occurs as it occurred before, under the condition that the listener is aboard the train. This test, therefore, does not conflict with the theory that time is stationary. Whether time be stationary or moving, the listener must, under these circumstances, hear the whistle at its true pitch, for he is accompanying it with the same effectiveness of hearing its true pitch as though he should stand by the railway's side at the moment when the blowing whistle passes.

But, mark, upon the theory that time is stationary, he would also hear, throughout the whole course of the mile, the true pitch of the whistle, even if he should stand at the railway's side. For, by the theory that time is stationary, there could be no lapses to his ear in the whistle's vibrations. Time being stationary, as the theory requires, the vibrations would reach him with the full number due to the whistle's normal pitch. The theory implies that time is indivisible, and therefore, that sonorous vibrations cannot be affected in transmission by the circumstance that their source is being whirled away through space, requiring, as science says, lapse of time, but, as the theory says, none. According to the theory, there is no relation of time to motion, and incidentally, to sound; for, if time be stationary, it cannot relate by action to any of its contents in the coexisting universe. That, as shown, it does not, according to the theory, harmonize with one of its contents; that it is, with relation to it, purely negative, is proof that it is not stationary. If time be stationary, the train passes through it without other relation to it than passage, which makes time's relation to it negative; but if time be moving, it accompanies the train, and its relations to any train's passage, or other motion of matter, whether relatively to it or to human observation of it, may be infinite. In the particular case before us, the relation, upon the hypothesis that time is moving, is fixed in various of these relations, notwithstanding that it is supposed to be moving, but, upon the hypothesis that time is stationary, there can be no correspondence between it and any movement in space.

So much may be said concretely, for the most part, in the case presented. It may, however, prove interesting to add the following word of pure generalization.

If time were, according to the theory, a something steadfast, through which all other things pass, instead of being a something which passes with them, it must be, as has been already mentioned, something indivisible. If it is not resolvable into units divisible by the arbitrary units of distance employed by humankind, their measurements of the relations of time, distance, and motion are merely imaginary. If time be stationary, it must be absolutely incapable of resolution into parts, just as the infinitude of space is similarly unresolvable. If time were stationary, it would be the only thing in nature unchangeable, of all that the human mind perceives of created things. It is, however, only under the condition of imagining the universe to be destroyed, that time is justly conceivable as

ceasing to exist; but certainly, if existing, not as ceasing to be. Kant, however, explicitly denies the proposition that time could cease with the abolition of matter and space. But it seems posterous not to regard time as an integral portion of the universe, vanishing with matter and space.

We must not imagine, from the ease with which this case is supposed of, that the distinguished men cited, who held to be true the theory that time is stationary, were not men of mind. They had little opportunity to obtain knowledge of acoustics and of other branches of science, of which even schoolboys have nowadays a smattering. There was, in their times, ancient down to modern, no Helmholtz, with his brilliant discoveries and teachings about fundamental notes and overtones and sound generally. There were no locomotives, clanging by with furious whistling, whose departing sound would doubtless have led them to the discovery of what is so plain to us of longer experience. They were as earnest in the search of truth as are any men of this era. One cannot but sympathize with St. Augustine when, yearning to solve the question regarding time, he burst forth into prayer as he wrote on the theme: "My mind burns to understand this most mysterious enigma. I do not desire to conceal, O Lord, good Father, in the name of Christ I beseech, I do not desire to conceal my longing. . . ."

Thus St. Augustine, in his ardor, interrupts from place to place in his works his discussion of the question as to time, reaching the conclusion that it is stationary.

Fénélon, in a most eloquent disquisition on the subject, reaches the same conclusion with St. Augustine. Kant is as diffuse on the subject as they, his summary being that the world generally receives the false impression of the movement of time from witnessing the decay of things. The Spanish theologian and metaphysician, Balme, remarks, in a note to his work, *Fundamental Philosophy*, that long before the Scholastics, the doctrine of the immovability of time had been taught by the most eminent authors, that Plato was not ignorant of this truth, that the Fathers of the Christian Church taught it, the Scholastics adopting the definition of Boethius: That eternity is "An interminable and simultaneously perfect possession of life."

But, really, this definition conforms with an idea of time, whether regarded as a moving or as a stationary phenomenon. Eternity in the existence of anything, or of everything, is conceivable, and moreover, is actually conceived, as existence with

mutability save as to the soul. If science, through observation and experiment, recognizes, as it does, the indestructibility of matter and of energy in the universe, it may well hold as true the idea of time as moving, while recognizing, through observation, constancy in its course. Motion, in a word, not quietude, is the law of the universe, so far as observation and reason have detected and enabled mankind to judge of creation.

What vitiates the conclusion of St. Augustine, Fénelon, Balme, and others regarding time is the concentration of their attention, not upon the pure and simple question as to whether or not time moves, but upon the maintenance of the eternal existence of God, which is not at all involved in the question. Consequent upon their conviction of this thesis, to the exclusion of everything else, they deem its corollary to be, that time is never past nor future, but always present; which is, of course, tantamount to believing that it does not move. The course by which they reach this conclusion from the postulate, that God is eternal, is the consideration that, were time moving, it would involve the consequence of admitting the possibility of the beginning and end of creation and creator. Therefore time, they conclude, must be ever present time. St. Augustine exclaims, speaking of eternity, "There, nothing is past, as if it no longer may be; nothing is future, as if it may yet be." Fénelon, in turn, exclaims, "But what does not pass, exists absolutely, and has but an infinite present." Fénelon, in the course of his long discourse on the subject of time exclaims, addressing God, "I always err whenever I depart from the present when speaking of you" [sic]. The fact is, that both St. Augustine and Fénelon wrote on the subject of time in religious ecstasy, which, in St. Augustine's case, takes the form of frequent recurrence to prayer, and in Fénelon's, that of a rhapsody throughout his treatise on the existence of God.

Father Buffier, on the contrary, treats the subject with what Balme regards as levity. "It seems to me," says Father Buffier, "that these notions are as clear as they can be, and he who seeks to make them still clearer, is about as little intelligent as he who would like to make clear how twice two are four, and not five."

Haeckel, who professes himself a Pantheist, says, "Since Kant explained space and time to be merely forms of perception,—space, the form of external; time, of internal sensitivity,—there has been a keen controversy, which still continues, over this important problem. A large section of modern metaphysicians have persuaded

themselves that this 'critical fact' possesses a great importance as the starting point of 'a purely idealist theory of knowledge,' and that, consequently, the natural opinion of the ordinary healthy mind as to the reality of time and space is swept aside. This narrow and ultra idealist conception of time and space has become a prolific source of error. It overlooks the fact that Kant only touched one side of the problem, the *subjective* side, in that theory, and recognized the equal validity of the *objective* side. 'Time and space,' he said, 'have empirical reality, but transcendental ideality.'"

How can Haeckel say that Kant touched only one side, when his own quotation from Kant defines both sides, and Kant says much more on the subject?

Although Kant does recognize time as known to common experience, he denies the *passage* of time when he tells us that we know it only through our perception of the decay of things. By both stating and implying that time stands still, he, of course, admits that time is real, but regards it only as a subjective reality, a form of human consciousness. Balmes, in his *Fundamental Philosophy*, remarks that Kant "asserts, without reason, that time in the things is nothing, and that it is only the form of our internal sense." As for Haeckel, he does not refer, in the quotation just made from his work on *The Riddle of the Universe* to the question as to whether or not time moves, but merely as to that of its empirical existence.

The fairest course to pursue is to select from Kant himself, among the numerous passages which he devotes to the subject, one that is conclusive as to his view. He says, "Our doctrine asserts, then, the *empirical reality* of time; that is, its objective validity in regard to all objects which may, on any occasion, be offered to our senses. And as our perception is at all times one of senses, there never can be given us an object in experience which is not submitted to the condition of time. But, again, we deny time all claim to *absolute reality*, if regarded as intrinsic condition inherent in things-in-themselves, irrespective of the form of our sensuous perception. Such attributes as belong to things-in-themselves can never be made known to us by the senses. In this, then, consists the *transcendental ideality* of time; which abstraction being made from the subjective conditions of sensuous perception, is absolutely nothing: and cannot be attributed to objects-in-themselves (or apart from their relation to our perception), whether as subsistent or inherent."

Further on, Kant answers objections made to this theory by persons who are not metaphysicians; but this passage from his

pen, in *The Critique of Pure Reason*, defining his view of time, will suffice for citation. It means, in sum, that time is a *phenomenon*, the appearance of an existence, and therefore, empirical; but that, of the corresponding *noumenon*, the thing-in-itself, we can have no knowledge.

But how is it consistent in Kant to deny, in one place, time as having any "absolute reality," to declare it an abstraction of sensuous perception, to be, in fact, "nothing," and yet, in another place, previously noted here, to regard it as the survival of a hypothetical abolition of matter and space? A *noumenon*, or thing-in-itself, is, in metaphysics, predicated of every *phenomenon*, or thing as it seems to be. But here Kant, in violation of metaphysical principles defines the nature of the *noumenon*. He defines it too, as "nothing." How, then, if it be "nothing," would it endure as time, were matter and space to vanish? How, metaphysically, can a *phenomenon* have any existence without a corresponding *noumenon*? Can a *noumenon*, moreover, on those terms, be "nothing"?

To English readers such a discussion as the preceding might seem singularly incomplete, if it should ignore Locke, so I conclude with a brief statement of his view regarding time. He remarks "There is another sort of distance, or length, the idea whereof we get, not from the permanent parts of space, but from the fleeting and perpetually perishing parts of succession. This we call *duration*, the simple modes whereof are any different lengths of it whereof we have distinct ideas, as *hours, days, years*, etc., *time and eternity*."

This expression makes it clear that Locke regarded time as moving, but, if more be needed, Locke's meaning is confirmed by Alexander Campbell Fraser, the editor of *An Essay Concerning the Human Understanding*, who, in a side-note to the passage quoted, prints, "Duration is fleeting extension."

The bounds mentally prescribed to this article have been reached. One might, with reason, had its dimensions been contemplated as broader, enter Hume and Leibnitz in the lists as contestants with regard to the essence of time, and going further, find a volume too small to include a history of the interminable war of ideas as to time, let alone those related to the questions of matter and space. Here, therefore, the limit has been reached which is practicable in a magazine for such a subject as that which has been here presented.

It seems to me, in summing up, that consideration of the previous discussion, coupled with due reflection upon the glimpse of creation

there afforded to sight, must bring conviction that time is not only real, but that it moves in profound compatibility with eternal motion in matter, from the myriad electrons streaming within the dancing atoms of agitated molecules, to suns so distant that they are far beyond even photographic vision of the earth. If an additional thought be permissible here, the question may be asked whether it is not credible that, as matter and energy, so far as we know them, are recognized as immortal, one may not rationally suppose that mind may survive. It may be answered, as if conclusively, that all energy, so far as we know it, is interchangeable in character, that nothing has been more conclusively proved than its constant mutability throughout the action of the correlation and conservation of energy. True, but the saving clause herein lies in the fact embodied in the words, "so far as we know," and justly, too, for discoveries in this department of knowledge have not ceased to the present day. It is conceived by many as probable, and by many more as certain, that there is a form of energy, not inextricably correlated to its generally recognized forms, variously termed mind or soul, through which, if so, the existence of Deity as its highest type is implied. Certain it is, that if one chooses to regard nature as wholly materialistic, a distinctly greater difficulty would seem to be thereby admitted by the question as to the possibility of its producing through evolution what is universally recognized as mind.

RICHARD MEADE BACHE.

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MATHEMATICAL ANALOGY.

An article by Mr. McFarland in *The Monist* of October of last year, calls attention to a fruitful source of error in the reasoning of many people, who have picked up a knowledge of mathematics at second-hand, and think they can apply it to reasoning about the question of miracles or about moral problems. The whole mass of misleading speculation on this subject rests on two initial false assumptions.

I. There does indeed exist a connection between religious and mathematical doctrine; but the parallelism is not, as many suppose, between facts in the history of Palestine and curves drawn in Europe or America; but between two psychologic conditions. Any attitude

of mind or sequence of mental operations which, if a man were trying to trace a curve, would lead him into error and make him mistake the false for the true, is, *a fortiori*, likely to lead him into some error if he is trying to trace out the relative values and get the resultant of a mass of complicated evidence about something long ago. Therefore, a sound mathematician tests the value of his reasoning about miracles, by asking himself whether a parallel line of reasoning would make him "prove" something not true if applied to the simpler problem of tracing a curve.

2. But there is a far more serious caution which should be given. The process by which a person, who is not himself an original discoverer in mathematics, arrives at understanding, or thinking he understands, a demonstration at second-hand, is absolutely different from any process by which an original mathematician makes a discovery. Now, when a real mathematician speaks of applying his mathematical method to religious or moral questions, he means the method by which he originally arrived at the mathematical truth, the method by which he got his own mind into a condition to receive new mathematical truths as an inspiration. No real mathematician would think of applying a demonstrative method, such as that criticised by Mr. McFarland about the curve, to any question connected with religion, morals, or miracles. That a great many pseudo-mathematicians do make the attempt is a sufficient reason for being very grateful to Mr. McFarland for exposing its absurdity.

An experiment is now being tried in England, of giving children a few years of steady initiation into the methods used by the great original mathematicians for training themselves for sound inspiration, before the children are allowed to be shown the logical demonstration of any geometric proposition whatsoever. The results are rather remarkable, and are attracting a good deal of attention. An account of the method of training will probably be published in the course of this winter. It is believed to be as nearly as possible the same as was used in very ancient times in Egypt and India for training the privileged or priestly caste.

M. E. BOOLE.

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THE MOSAIC LAW AND THE CODE HAMMURABI.

To the Editor of The Monist:

In the April number of *The Monist*, 1905, page 200, my Hammurabi theory is alleged to maintain that both the codes of Palestine (viz. the Mosaic law) and Babylon have been derived through "a regular development of certain principles of primitive Semitic social life."

This is a mistake, and obviously Dr. Godbey, the author of the mooted article, confuses what I say concerning the *Urgesetz* and the *Ursemitisch*. By the latter is meant primitive Semitic life; by the former, which I have also called "archetype," I understand (as careful reading of my book will show) a definite Babylonian law antedating Hammurabi.

Accordingly, the objections made by Dr. Godbey are irrelevant, for it was my very purpose to prove that

1. A close connection exists between the Mosaic law and the Code Hammurabi;
2. The Mosaic law has not been derived from the Code Hammurabi; and
3. Both have been derived from an "archetype," i. e., a more ancient Babylonian law.

PROFESSOR D. H. MÜLLER.

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IN THE BEGINNING.

"In the beginning God created the heaven and the earth." Thus opens Genesis, with a statement that has since remained a problem. The general interpretation of it is that the universe, as we know it, came into being at some fixed period in eternity. To this science has added the conception that it has since gone through a long process of evolution, is now running down like a clock whose spring is weakening, and is destined to lose its vitality at some fixed future period.

Such is the dictum of Scripture and of science. Can we accept it? It must be said that the mind of man revolts against it, rendering the involuntary verdict that time had no beginning and can have no end. Before "the beginning" what? is an inevitable question. After "the end" what? is as inevitably asked. Did God exist from eternity alone and call matter into being from absolute nothingness? Will God exist through a later eternity

alone, in company with the dark and dead spheres of the universe? Man's reason enters a strong protest against any such dogma. From the dawn of civilization we hear this protest, in the doctrine of the old Brahmanic philosophers, who maintained that matter and spirit are co-eternal and one in essence, that a self-conscious Deity infiltrates and controls matter, and that the conscious spirit of man is but an atom temporarily set aside from the infinite consciousness of the Deity, into which it is destined to return.

So far inspiration and philosophy take us. But in modern times many have ceased to put faith in either inspiration or philosophy, accepting facts only, and taking refuge in the cave of the Agnostic from those vast problems which sweep beyond the reach of human thought. This is, perhaps, a somewhat barren attitude. In the absence of facts bearing upon these questions it is difficult—impossible, it may be—to escape from speculative dreams and problematical theories, and science is as great a sinner in this direction as theology. But in regard to the problem of "the beginning" we may justly ask, what do facts teach? Is there anything known to man that will aid in its solution? Yes, let us answer. There are facts of astronomy known at the present day which seem quite out of consonance with the old doctrine, and teach us that, instead of one definite beginning, there have been countless beginnings in the evolution of the universe, some dating back myriads of years, some of comparatively recent origin, some still in the throes of birth, some whose germs alone as yet exist. And if so with the beginning, it may be so with the ending. The end of spherul evolution may have been reached in many instances. In others it is still myriads of years in the future. As to whether each of these endings will prove the germinal point in a new beginning is a matter far beyond our ken.

As for the facts bearing upon the case, they are numerous and significant. When we look upward upon the vast array of suns which stud by millions the nightly skies, what do we behold? Not a multitude of spheres of the same apparent age, as we might expect under the prevailing hypothesis, but an innumerable series of solar orbs of every age and stage of growth. As we look downward on our own race, we perceive the new-born infant, the child, the youth, the mature man, the man of middle age, the old in whom the seeds of death are sown, and finally the lifeless corpse. As we look upward into the star-studded heavens we behold something strikingly analogous. Spheres lie there in every stage of growth, from early infancy to decrepitude, if such a parallel is admissible. The host of stars that stud the sky may well seem to our uninstructed eyes of the same age and condition. But the telescope tells a different tale, and the revelations of spectrum analysis have taught us remarkable lessons about those distant spheres. As regards the light-giving suns, those which, like our own solar orb, are probably the

ruling centers of families of planets, there are evidently very great differences in age. Father Secchi, the noted priest-astronomer, forty years ago divided them, on the basis of their spectra, into four types: (1) The white stars, like Sirius and Vega, held to be young and intensely hot; (2) The yellow stars, like Aldebaran and our own Sun, of mature age and diminishing heat; (3) The red stars, with spectra presenting fluted bars, fainter towards the violet end,—in these old age is fast coming on; (4) The faint, deep-red stars, with wider fluted bars and spectra fading towards the red end,—the light of these is supposed to be near extinction. Secchi's views, a revelation when made public in 1865, have since been generally accepted by astronomers, who now hold that the light-giving stars of the heavens differ immensely in age, some being millions, perhaps billions, of years older than others. It is true that certain changes have been suggested in Secchi's types. Type 3, for instance, is placed by Lockyer at the beginning of the series. But the general fact involved in them is undoubted by astronomers.

Yet this is only a starting-point. Since Secchi's time astronomy has made many steps of advance. We now see far before and after. The youngest known to us is already far advanced in its life career. We are familiar with much younger forms. The oldest light-giver has a long course yet to run, and many being known of far greater age. We are aware of the existence of suns, orbs that have long lost their light and sunk into blind old age. We are similarly aware of the existence of embryo suns, in many stages of development. The story of the stars spreads before us in remarkable completeness, and we see the tenants of the heavens in every stage of existence, from infancy to dotage.

Let us begin with the stage of solar childhood. Nebulæ, the germinal forms of stars, are now known in great numbers. Thousands of them exist, of all sizes and many shapes. They are visible in the telescope from the vague nebulous matter to the sphere whose recent origin is shown by the nebulous cloud still clinging around it. Between these extremes are many phases of development, which are classed as annular, elliptic, spiral, and planetary nebulæ and nebulous stars. The tendency to assume the spiral form is strongly marked among them, and we see this in what seem various stages of condensation. The planetary nebulæ show faint disks, as of solar globes gradually forming out of the original fire mist. The nebulous stars are the final stage of star birth, in which a trace of the nebula remains, the condensation not being quite complete. Such is, very briefly told, the story of star generation, so far as we are familiar with it. The details of this story, now known to astronomers, give excellent warrant for the general belief that the nebula is the mother form of the star and that in its varied forms we have set out before us the genesis of the suns.

Passing now to the later stages of the process of solar evolution, we move onward through the various types of stellar progress to the faint and fading dark-red sphere, and thence to the dark star, the burnt-out sun, the solar globe whose light was extinguished long ages ago. How many of these exist in the skies we do not and can not know. That we know of their existence at all is a remarkable example of the magic of science. That astronomers should have been able to discover orbs of darkness in the heavens, trillions of miles distant from us, seems incredible, yet they are to-day quite as convinced of the existence of these lightless stars as of our sun itself. Their discovery forms an interesting chapter in modern science. We must speak of it with great brevity, yet perhaps can make its method evident in a few words.

The peculiar variations in the motions of the bright stars Sirius and Procyon gave rise, more than half a century ago, to the theory that these changes, periodical in character, were due to the presence of dark companions. It was held that Sirius, for instance, was accompanied by a dark orb—a planet, let us say, of monstrous size,—and that the two revolved round each other. Sirius alone could be seen, but the strange fluctuations in its motions seemed to point to a sister orb near by, by which it was pulled out of place. This theory was received at first with much incredulity. Fortunately, in 1862, by the use of a new and powerful telescope, the companion star was discovered. It was not quite dark, it yielded light enough to reveal itself, though its brilliance was ten magnitudes less than that of Sirius. In mass Sirius was twice the larger, a fact discoverable by the strength of their mutual attractions. By great good fortune the dark companion of Procyon was similarly found, at a later date. In 1896, when the powerful lens of the Lick Observatory was turned upon this star, its companion became visible, a light-giver indeed, but twelve magnitudes in visibility below Procyon.

These discoveries, we have said, were fortunate. They demonstrated the truth of the theory in these two instances and thus gave warrant for its application in many other similar instances, where the dark companion continued obstinately invisible. There are many variable stars, several hundreds of them being now known, in which the light fluctuates at fixed intervals, declining in intensity for a period of greater or less length, then regaining its full strength. An explanation of this is that a dark companion revolves around the visible star, cutting off part of its light when passing between it and our eyes. Periodical fluctuations in the motion of these stars go to show that this explanation is the correct one. The bright star Algol, for instance, is known to have such a dark companion, which at once affects its motion and its light. It does not cut off all the light, and therefore seems to be of smaller size, but its influence on the motions of Algol proves it to

have twice the mass of the latter, and in consequence to be much more dense and compact. It may be said further that most of the variable stars—but not all—have spectra of the fourth type, showing that their light is approaching extinction.

As in the cases of Sirius and Procyon, all of these dark companion stars may be light-givers to some extent, but rarely sufficiently so to be detected by the telescopic power at our command. There is another matter here calling for comment. The companions seem of very different age. There are two possible explanations of this. Either their constitution differs, so that one has lost its light-giving powers more rapidly than the other, or they were originally separate tenants of the skies, and became companions as a result of approach and mutual attraction.

We have no means of discovering the existence of dark stars except those given, and can never hope to detect them unless they are companions of light-givers. Thus our powers in this direction are restricted to a very small percentage of the whole multitude of stars, and though we may with some justice conjecture that there are myriads of independent stars of this character, we cannot demonstrate this. Yet we have a reason for believing in it other than the known existence of many dark stars. This is the fact that the visible stars show successive stages of development, from the brilliant white globe to the dark red orb whose light seems fading out. It seems safe to conclude that this process continues till the stage of invisibility is reached, and we may even conjecture that it goes on in many cases till the star has lost its heat as well as its light and has reached the end of its career as a vital tenant of the skies.

To return, now to the title of this paper, "In the Beginning," we are justified in asking: When was that beginning? Have not the actual beginnings been countless in number, as many as there are independent stars in the skies? The heavens seem to tell the story of multitudinous beginnings and endings, births dating back to almost infinite periods in the past and births now taking place before our eyes; while between them lies every stage of development from infancy to old age and death. The "beginning" taught by Scripture can apply to our solar system only, the sun and his family of planetary bodies. It evidently has no application to the universe as a whole.

Such appears to be the inevitable conclusion so far as our knowledge of facts leads us onward. Yet we may have some justification in taking one step into the kingdom of speculation. Two chapters are missing from our volume, the one that precedes the faintly visible nebula, the one that follows the traceable dark star. In the one case we are in the presence of an early stage of life; in the other in that of a stage far advanced towards death. What went before and what comes after? Is it not possible that the beginning

and the end may shade together and death be the herald of a new life? May not the dead sun, through some process of disaggregation of which we know and can know nothing, break up into its primal elements, dissolve to form a new nebula, and thus return to the stage of "The beginning," ready to set out again on a new career of evolution?

This is conjectural; no one can say that it is impossible; for, in spite of the theory of the irreversible dissipation of energy, we remain blankly ignorant of the forces of aggregation and disaggregation which may exist in the universe, and are incapable of placing a limit to its possibilities of change. If, for the sake of the argument, it be granted that such a reversal in the action of forces may be possible, it opens to us a wonderful vista into the process of creation and eternity. In a universe in which the old starts out again, by a natural evolution, as the new, there could be no beginning and no end. Every sphere would run its separate course for myriads of years, and then give birth to a new sphere, again to run a course of vast duration, and eternity would be a process of births and deaths unceasing, with all the wondrous panorama of spheral life stretched out between.

This view may be looked upon by many as heterodox, and as out of consonance with the dogmas of orthodox science. But the facts stand before us and the strictest orthodoxy cannot set them aside. The universe is not a realm of one beginning and one ending, but may have had almost as many beginnings as there are separate stars, many of the tenants of space being myriads of ages older than others. Whence do the new nebulae come unless there is material provided for them? And whence does this material arise? Is it matter newly created for the purpose or old matter transformed and fitted to run its evolutionary race again? Modern science is very unlikely to accept the former view, but if it accepts the latter we are led to the inevitable conclusion that the processes of the universe are continual, not transitory, and that spheral evolution may well be a process eternal in duration,—without beginning and without end.

CHARLES MORRIS.

PHILADELPHIA, PA.

BOOK REVIEWS AND NOTES.

DER SKEPTIZISMUS IN DER PHILOSOPHIE. Erster Band. Von *Raoul Richter*, Privatdozent an der Universität Leipzig. Leipsic: Dürr. 1904. Pp. xxiv, 364. Price, 6 marks.

The purpose of this book is to find the narrow path to truth by investigating those philosophies which claim either a total or a partial scepticism as the only possible solution of the philosophical problem. The present volume contains an historical exposition of the ancient Greek Skepsis, especially Pyrrhonism, and the Academic Skepsis. The second volume which has not yet appeared, will attack the more important problems of modern partial scepticism and will also be devoted to an investigation of the immanent scepticism which is contained in the transcendent dogmatism of a Pascal and other mystics as well as the transcendent scepticism of Kant.

We hope to find opportunity of saying more of the first volume when the second appears.

ERKENNTNIS UND IRRTHUM. Skizzen zur Psychologie der Forschung. Von *E. Mach*, Emer. Professor an der Universität Wien. Leipsic: J. A. Barth. 1905. Pages, 461.

Erkenntnis und Irrthum is a collection of lectures and essays on the psychology and logic of science. Part of them were delivered as lectures at the University of Vienna in the winter of 1895-1896. Three of the essays, viz., those on "Psychological and Metrical Space," on the "Psychology and Natural Development of Geometry," and on "Space and Geometry from the Point of View of Natural Inquiry," are reprinted from *The Monist* of 1902-1903, for which they were especially written. These essays, which constitute perhaps the most original part of Professor Mach's new work, will be published in English in book form this spring, by The Open Court Publishing Co.

We hope to publish a more detailed review of Professor Mach's views on "The Origin and Nature of Science" in a later number of *The Monist*. The titles of the essays of the present volume have a familiar sound to all readers of Professor Mach's former publications. We append a few: "The Concept," "Adaptation of Thoughts to Facts," "Experimenting in Thought," "Hypotheses," "Number and Measure," "Space from a Physical Point of View," "Meaning and Value of Natural Laws."

Like all of Professor Mach's writings, the present work contains a host

of brilliant and suggestive contributions to the philosophy of science. He has placed many of his old points of view in an entirely new light, and has put into connected and systematic form much material which until now has lain scattered and inaccessible in his more fugitive writings. The essays are marked by the same calmness, simplicity, and moderateness of expression, which have become an unfailing and distinguishing characteristic of all of Professor Mach's writings.

POPULÄRE SCHRIFTEN. By *Dr. Ludwig Boltzmann*. Leipzig: Barth. 1905. Pp. 440. Price, 8 marks. Bound, 9 marks.

Professor Boltzmann, the leading physicist of Germany, and successor to Professor Ernst Mach at the University of Vienna, offers in this volume a collection of lectures and essays which have appeared during the last decade. The constituents are very irregular, partly scientific and partly mere *causeries*. He discusses Maxwell's theory of electricity, the mechanical theory of heat, the significance of theory in general; and other problems within the domain of mathematics, mechanics and physics. He criticises his rival Ostwald and devotes several lectures to such great men as Kirchhoff, Joseph Loschmidt, etc. He devotes a scathing criticism to Schopenhauer, scorns philosophy in contrast to exact science, defends the mechanism of atomistic principles, not as absolute but as indispensable, and finally winds up with a report of his journey to America. He had been invited to lecture at the University of California, and he does not hesitate to give us the impression which he had during his hasty trip to the Pacific Ocean. His account is sometimes very humorous, although the humor may not always be intentional, for he tells us of his sufferings from heat and thirst and dust, and conditions to which he is not accustomed.

Dr. Hans Kleinpeter, an admirer and one of the most prominent disciples of Professor Ernst Mach, offers an exposition of Mach's conception of science and the world in his article "On the Monism of Professor Mach," which appears in the present number of *The Monist*. We count ourselves among the admirers and personal friends of Professor Mach, but we would say that in some salient points we do not endorse Dr. Kleinpeter's view. Though Professor Mach has worked out his views independently of other thinkers and though his method of dealing with facts may be rightly regarded as original, we do not accede to Dr. Kleinpeter's opinion that Mach's philosophy is as unique as he represents it. As to our own opinion we have to say that there are differences, and whether or not they are to be considered important depends very much upon the view which Professor Mach would take of them himself. We feel inclined to enter into details and make a resumé of the points of agreement and apparent discrepancies, but we abstain from it in the present number, reserving the subject for a future issue in case it would be deemed welcome to our readers.

ERRATUM.

Our attention has been called to an important typographical error in the department of "Criticisms and Discussions" in the January *Monist*. In Mr. Peirce's contribution to "Mr. Peterson's Proposed Discussion," on page 144 line 25, the last word should read "definitive" instead of "definite."

FOUNDATION OF A LAY CHURCH

WHAT is the reason that so many people, and sometimes the very best ones, who think, stay at home on Sunday and do not attend church? Is it because clergymen preach antiquated dogmas and the people are tired of listening to them; or is it because the Churches themselves are antiquated and their methods become obsolete? To many these reasons may seem a sufficient explanation, but I believe there are other reasons, and even if in many places and for various reasons religious life is flagging, we ought to revive, and modernize, and sustain church life; we ought to favor the ideals of religious organizations; we ought to give the busy world opportunities for the busy world to ponder from time to time on the ultimate questions of life, the problems of death, of eternity, of the interrelation of mankind, of the brotherhood of man, of international justice, of universal brotherhood, and other matters of conscience, etc.

The Churches have, at least to a great extent, ceased to be the guides of the people, and among many other reasons there is one quite obvious which has much to do with religion and dogma. In former times the clergyman was sometimes the only educated and scholarly person in his congregation, and he was usually the leader of his flock. But education has spread. Thinking is no longer a clerical prerogative, and there are more men than our ministers worthy of taking part in matters of a religious import. In other words, formerly the pulpit was naturally the ruler in matters ecclesiastic, but now the pews begin to have a voice too.

Wherever the Churches prosper, let them continue their work; but for the sake of the people over whom the Churches have lost their influence the following proposition would be in order, which will best and most concisely be expressed in the shape of a ready-made

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The first issue of *The Monist* for the year 1906 is more than usual interest. Professor Lindemann, of the University of Munich, contributes an article, "On the Form and Spectrum of Atoms," which demonstrates the possibility of distinguishing the forms of different elemental atoms from the lines of their respective spectrums, and thus mechanically accounting for their different chemical combinations. This article is ably supplemented by "Manifestations of Ether," by Mr. W. S. Andrews, while both of these presentations tend to strongly confirm the electronic theory.

Professor Keyser, of Columbia University, in an essay entitled "Mathematical Emancipations," endeavors to make clear how the imagination of the untechnically educated may grasp the idea of multi-dimensional space.

Professor D. T. MacDougal, editor of the English edition of De Vries *Species and Varieties: Their Origin by Mutation*, adds greatly to the value of the number by his contribution on "Heredity and the Origin of Species," in which he makes public significant results from many interesting experiments of his own in the New York Botanical Garden.

Inspired by Mr. Andrews' article on "Magic Squares" in the two preceding numbers, Dr. Carus offers some philosophical "Reflections on Magic Squares," bringing out the possibility of constructing them on the principles of the laws of symmetry, and showing how mathematical considerations such as these help to solve the God problem in the philosophy of science.

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THE MONIST

ORIGIN OF THE MARINERS' COMPASS IN CHINA*

THE reign of Ch'öng-wang (B. C. 1115-1079) has been quoted by Chinese and foreign authors alike as being the period during which the north-, or as the Chinese say, south-pointing qualities of the magnetic needle were discovered. In the sixth year of his reign, so the legend runs, Ch'öng-wang received the news that the ambassadors of a distant foreign kingdom, called the tribes of Yüé-ch'ang, had arrived with presents to do him homage. They were at home in the south of the country of Kiauchī, i. e., the present Tungking. Later Chinese historians placed them at the very spot where, during centuries at the beginning of our era, the embassies from India (T'ién-chu) and Syria (Ta-ts'in) disembarked, in order to be conveyed to the Chinese Court, and where, according to the *Shui-king-chu*, a geographical record of the fifth century A. D., ships used to start for the journey south to the countries of the Malayan Peninsula. This place clearly marks what may be called the terminus of Western navigation as described on the Chinese side, which is probably identical with Ptolemy's city of Cattigara, the terminus of shipping enterprise in the Far East according to western classical authors. The emperor gave orders that the Yüé-

* From the author's lectures on the History of China, delivered at Columbia University, New York.

ch'ang ambassadors should be conducted to the court and that great honor should be paid them. The ambassadors were accompanied by interpreters speaking different languages and brought pheasants and the tusk of an elephant as tribute. Since they were in doubt as to how to find their way back to their home, the Duke of Chóu, the Emperor's uncle and prime minister, is said to have presented them with five chariots provided with a south-pointing contrivance (*ch'i-nan-kü*, i. e. "south-pointing chariots"). Thus they found their way back "to the seas of Fu-nan and Lin-i," the last named country, well known during the Han Dynasty, containing the territory from which they had come, as Legge (*Shu-king*, p. 535, *seq.*) has pointed out.

No trace of this embassy and the south-pointing chariots mentioned in connection with it is contained in the *Shu-king* and the *Shi-ki*. Legge, therefore, looks upon it as a myth. Nevertheless we possess early traces of the belief in such an invention, as being made, if not by Chóu-kung, at least by some one among the old rulers. The philosopher Han Fei, who died in 233 B. C., says in one of his essays (*Han-fei-tz'i*, chap. 2, p. 4): "The early kings constructed the *ss'i-nan*, i. e., 'the south-pointer,' in order to fix the position of morning and evening." And a still earlier philosopher, Kui-ku-tz'i, who lived in the fourth century B. C., refers to the people of Chöng (K'ai-föng-fu) as having made use of the "south-pointing chariot" (*ss'i-nan-kü*), when sending for jadestone (s. *Kui-ku-tz'i*, sec. 10 of his book). Kui-ku-tz'i, whose little work is not completely preserved, is also quoted in the *T'ai-p'ing-yü-lan*, a cyclopedia of the tenth century, as having said:

"The Su-shön (which is the same name by which, many centuries later, the Nü-chön, Ju-chi, or Djurdjen Tartars, the Tungusic ancestors of the Manchus, were known, but in this case probably represents an unknown barbarous tribe somewhere near the Chinese dominion mentioned

the *Shu-king*, Legge, p. 12, par. 56) offered a white pheasant to Wön-wang. Lest they might lose their way on the journey, Chóu-kung constructed the 'south-pointing chariot' to accompany them" (Legge, *Shu-king*, p. 537).

Possibly Wön-wang and Ch'öng-wang were confounded in this passage. Kui-ku-tzī's text contains yet another passage (p. 4B), in which he speaks of "loadstone attracting a needle," but since this need not necessarily involve a knowledge of the magnetic compass, I would lay no stress on it. From all this it would appear that as early as the fourth century B. C. some sort of a contrivance indicating southern direction either existed or was believed to have existed formerly. In the later literature, the term *chī-nan* (from *chī*, "to point with the finger," and *nan*, "south," and identical with *ssī-nan*) is occasionally used metaphorically, for instance in the History of the Three Kingdoms (*San-kuo-chī*: Shu, chap. 8, p. 4B), from which it would appear that the term was quite current in the sense of "a guide" about the year 200 A. D. Yet we have no indication whatever to show what the south-pointing chariot, or *chī-nan-kü*, was in reality. We do not hear of the magnetic needle being used as a compass in connection with it any more than on board ship for several centuries after the downfall of the Chóu dynasty, and if the needle was at all at the bottom of those chariots, the invention of which was attributed to the Emperor Huang-ti in one, and to Chóu-kung in another passage of the *Ku-kin-chu*, a work of the fourth century A. D., we possess no record showing how they were constructed. From an account of the history of this invention contained in the *Sung-shu*, a historical work of the fifth century (chap. 18, p. 4) it appears that the secret of the "south-pointing chariots" had been lost for many centuries, when the eminent astronomer Chang Höng, who died in 139 A. D., reconstructed it. In the troubles causing the downfall of

the eastern Han dynasty his model, too, was lost and consequently forgotten.

Since the third century A. D. renewed interest began to be taken in these mysterious allusions of the ancient literature, which led to repeated attempts to reconstruct what the would-be reconstructors apparently mistook as mechanical contrivance, and it appears that all that was turned out was a machine consisting of certain wheels, possibly registering the movements of the axle of a chariot in such a manner as to cause an index hand to point in the same direction, whatever direction the chariot might take. I do not know whether such a construction is actually within the range of possibility; if so, I would be inclined to think that these re-inventions were used as mechanical toys to be kept in some Imperial museum as models supposed to correspond with Chóu-kung's chariots and doomed to oblivion as being practically useless. I find it stated in the *Sung-shu*, to which account Prof. H. E. Parker has drawn attention in the *China Review* (Vol. XVIII, p. 197), that certain models made under instructions from Shī Hu, the emperor of a short-lived foreign dynasty in the middle of the fourth century, and from Yau Hing, an emperor of the later Ts'in dynasty (about 400 A. D.), fell into the hands of the Sung Court in A. D. 417, but "the machinery being too coarse, the south-pointer showed so often in the wrong direction that men were required to set it aright again." Subsequent attempts are spoken of as having been more successful, but as I understand the *Sung-shu*, the author of this account thinks of "machinery" and is not aware of the real agent, although he casually remarks that, during the Tsin dynasty (265-420 A. D.) there was also a *chī-nan-chóu*, i. e., "a south-pointing ship." The Emperor Yau Hing's contrivance is more clearly described in the biography of its engineer (*Nan-ts'i-shu*, chap. 52, p. 15), which says it had no machinery at all, but that,

whenever it was put in motion, a man had to step inside to move the apparatus. Trying to read between the lines, I am inclined to assume that this remark strongly suggests the use of a compass, the man who had to step inside giving the chariot the direction ascertained from it. Yet we find in the *Sung-shi* (chap. 149, p. 15) the detailed description of the model of a "south-pointing chariot," seriously submitted to the Emperor Jön-tsung as late as 1027 A. D., based on a most complicated system of cogged wheels, diameters and numbers of cogs being given, and said to have been originally constructed about 806 A. D. A similar machine, also described in the *Sung-shi*, was constructed in 1107 A. D., when it was submitted to the Emperor Hui-tsung. At this time we can, from other sources, show reason that the magnetic needle must have been well known, if not as a guide to mariners, at least as an instrument seen in the hands of geomancers for centuries before that date. Dr. Edkins, in his paper "On Chinese Names for Boats and Boat Gear," quotes Mr. Wylie in showing that the Buddhist priest and Imperial Astronomer I-hing at the beginning of the eighth century knew not only the south-pointing qualities of the magnetic needle, but also its eastern deviation (*Journal of the China Branch, Royal Asiatic Society*, N. S., Vol. XI, p. 138). Since no references are given, I am not able to confirm the fact, but I am certain that the deviation of the needle was well known in China about the year 1115 A. D., when it was described in the *Pön-ts'au-yen-i* (quoted in the *Ko-chi-king-yüan*, chap. 49, p. 12B). It was then stated that, if you rub a needle with loadstone, it will point to the south, but that it will always deviate a little to the east and not show due south. To prepare the contrivance one had to single out a fine thread from a new skein of silk floss and fix it with half a candareen of bees' wax on the middle of the needle, the latter to be hung up where there was no wind. The

needle would then always point to the south. By sticking the needle through a piece of lamp wick (which in China is made of pith) and thus causing it to float on the water it would also point to the south with a slight deviation which the author tries to explain from the mystic point of view of Chinese natural philosophy. Shön Kua, who wrote about the middle of the 11th century, gives us still clearer account of the contrivance, which according to his own words was used by the *fang-kia*, or geomancers, and he says absolutely nothing about its use in navigation. He also describes the deviation of the needle, without any attempt at explanation. For, "the reason, why loadstone points to the south, just as cypresses point to the west, cannot be explained" (*Möng-k'i-pi-t'an*, chap. 24, p. 7B). Since Shön Kua was a native of Hangchow, where lively traffic existed in those days with Arab and Persian traders, it seems quite possible that the latter have seen the needle used for geomantic purposes somewhere in that neighborhood, if not in Chinchew (Zai-tun) or Canton, learned the secret of its preparation from the Chinese and discovered its further use in navigation.

The *Ch'au-yé-ts'ién-tsai* (a work of the eighth century A. D. quoted in the *Ko-chi-king-yüan*, chapter 29, p. 25) states that in 692 A. D. a mechanic was sent to court from Hai-chóu, a seaport on the coast south of Kiau-chóu (Shan-tung), who had constructed a "chariot showing the twelve hours of the day" (*shü-ir-ch'ön-kü*) by the shaft being turned due south. It looks very much as though the magnetic needle had something to do with it, too. It may have been a mechanical toy to be used indoors, somewhat like another "south-pointing chariot," so styled and described on the preceding page of the cyclopedia referred to as being only seven and a half inches long and about fifteen inches high, and not a chariot in the ordinary sense.

The earliest unmistakable mention of the use of the magnetic needle as a guide to mariners I have been able to find in Chinese literature, is probably as old as the knowledge of its use in Europe. It occurs in a work of the twelfth century, entitled *P'ing-chóu-k'ó-t'an* and compiled by one Chu Yü, a native of Hu-chóu in Chö-kiang. In the second chapter of this work the author has inserted a series of notes on the foreign trade at Canton, which, previous to the arrival of the Portuguese in Eastern waters, was in the hands of Arab and Persian navigators. Since, from what we know of the author's lifetime, he has never himself lived at Canton, whereas his father, Chu Fu, had held office there at the end of the eleventh century, the critics of the great Catalogue of the Imperial Library at Peking (*Ts'ung-mu*, chapter 141, page 15 *et seq.*) hold that his information about the foreign trade in Canton is based on accounts of Chu, the father, and that it, therefore, dates from the latter part of the eleventh century A. D. This view is supported by the fact that the years A. D. 1086 and 1099 are mentioned in Chu Yü's paragraphs referring to Canton in other connections. Among these interesting notes I find (chap. 2, p. 2) one referring to the foreign ships by which trade was carried on between Canton and San-fo-ts'i (Palembang) on the east of Sumatra and farther on to the ports in Arab countries, including India. It runs as follows:

"In clear weather the Captain ascertains the ship's position at night by looking at the stars, in the daytime by looking at the sun; in dark weather he looks at the south-pointing needle (*ch'i-nan-chön*). Sometimes he will make use of a rope, ten chang in length, to hook up mud from the bottom of the sea, the smell of which will tell him where to go to. In the open sea there is no rain, and when it rains, they are nearing land," etc.

The wording of the passage is of such a kind that it

does not give us any clue whether the Chinese at the time were, or were not, familiar with the use of the compass on board ship. I am inclined to think, however, that attempts to use the needle on board must have been made in China about as early as it was known there to geomancers, but that it was abandoned as a useless luxury by the conservative junk masters, who were accustomed to steer their ships by taking bearings and soundings and scarcely ever required a compass for their coasting trips. Navigation on the high seas in those days was in the hands of foreigners (Arabs and Persians), and this may be the reason why we first hear of them as having turned the old Chinese invention to practical use on shipboard.

We have seen that, apart from the great probability of the magnetic needle being known in high antiquity, instances are on record of its being used during the middle ages for geomantic purposes. If my assumption that the magnetic needle was seen by Arab traders on the coast of China in the hands of geomancers, applied by them to navigation and then brought back to China as the "mariners' compass," proves correct, the history of this invention may be looked upon as perfectly analogous to that of gunpowder, the preparation of which was probably known to the Chinese long before they learned its application to fire-arms through Europeans.

ABSTRACT OF DATES.

- B. C. 2704-2594. The invention of the "south-pointing chariot" ascribed to the legendary Emperor Huang-ti according to the *Ku-kin-chu* (4th cent. A. D.).
- B. C. 1231-1135. "South-pointing chariots" were presented by Wön-wang to certain ambassadors. The passage, which may be wrongly handed down, is contained in the *Kui-ku-tz'i*, a work of the fourth century B. C.
- B. C. 1115-1079, under Ch'öng-wang. Legend of the arrival of ambassadors from the south, conducted home by the aid

- of "south-pointing chariots." No indication is on record to say what these were. The entire account is legendary and not backed by contemporaneous records.
- B. C. 4th Century. The philosopher Kui-ku-tzī speaks of the "south-pointing chariot" as being used by the people of Chōng. He knows that loadstone will attract a needle.
- B. C. 233. The philosopher Han Feī speaks of a "south-pointer" by which the position of east and west may be ascertained.
- A. D. 139. The astronomer Chang Hōng tries to reconstruct the old "south-pointing chariot." His model, however, became lost and forgotten.
- A. D. 200. The term *chī-nan* ("south-pointer," or "compass") is used figuratively in the sense of "a guide." *San-kuo-chī*.
- A. D. 350-400. The Emperors Shī Hu and Yau Hing are in the possession of apparatuses pointing south, but the "machinery" being coarse, they point wrong (*Sung-shu*), and in Yau Hing's contrivance a man is required to move it (*Nan-ts'i-shu*).
- A. D. 265-420. "South-pointing ships" (*chī-nan-chōu*) are mentioned.
- A. D. 692. A south-pointing contrivance showing the hours of the day is invented.
- A. D. 700. The Buddhist astronomer I-hing is familiar with the eastern deviation of the magnetic needle. Edkins, quoting Wylie. Wylie, in a paper entitled "Magnetic Compass in China," reprinted in *Chinese Researches*, (Shanghai, 1897), p. 155, says:
- "A passage from the life of Yih-hing, a Buddhist priest and imperial astronomer at the commencement of the eighth century, will show that the subject had engaged attention at least 900 years earlier [than the seventeenth century]. It is said, that 'on comparing the needle with the north pole, he found the former pointed between the constellations *heu* and *wei*. The pole was just in 6 degrees of *heu*, from which the needle declined to the right (east) 2° 95'. As it declined to the right of the north pole, it was neces-

sarily to the left of the south pole.' " I have not succeeded in finding this passage in the lives of I-hing was able to consult, but take it for granted on the excellent authority of the late Mr. Wylie that it is contained in some other Chinese text, which I hope to be able to hunt up some day. Unfortunately neither Mr. Wylie nor Dr. Edkins have given us chapter and verse of this passage so very important in the history of our subject.

- A. D. 806. A south-pointing contrivance consisting of cogged wheels is said to have been constructed in the *Sung-shi*.
- A. D. 1027. A "south-pointing chariot," described as a mechanical contrivance, is submitted to the Emperor Jön-tsung *Sung-shi*.
- A. D. 1030-1093. Lifetime of the encyclopædist Shön Kua, who speaks of the magnetic needle and its deviation as used for geomantic purposes.
- A. D. 1100, or sooner. Probable first unmistakable mention on record in Chinese literature of the "south-pointing needle" on board ship as being used by foreign (Arab and Persian) navigators at Canton.
- A. D. 1107. A "south-pointing chariot," also described as a system of cogged wheels, etc., is submitted to the Emperor Hui-tsung.
- A. D. 1115. The magnetic needle is described in detail and its deviation mentioned in the *Pön-ts'au-yen-i*, where no allusion is made to its use on board ship.

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PROFESSOR MACH'S PHILOSOPHY.

AMONG our contemporary thinkers Prof. Ernst Mach is distinguished by independence and exactness of thought and an absolute absence of pretension which with all his prominence in the history of science renders him pretty nigh one of the most amiable men in the world. He has crowned his life's work by a new volume, entitled *Cognition and Error*,* in which he discusses methods of scientific enquiry and points out the sources of error. Professor Mach is original in the sense that he does not rely on others but goes his own way. He has been influenced by great thinkers in both philosophy and physics, but he has not become the disciple of any one of them, and we would say that the main points on which he insists are, first, his distinction between theory and fact, and secondly, his observation of the *modus operandi* of science itself which he finds in an economy of thought. This economy leads to simplification finally implying a system of monism, and in this sense Mach may be called one of the leading monists whose theory, however, is tentative and empirical, not dogmatic or metaphysical.

Mach's aim from the beginning has been to eliminate the many errors and implications that arise from a wrong conception of our intellectual tools. Theories are frequently regarded as the main thing, and facts as incidentals,—in consequence of which theories are looked upon

**Erkenntniss und Irrthum*. Leipsic: J. A. Barth, 1905.

as ontological principles and constitute the basis of all metaphysicism which has been dominating in both philosophy and science.

As soon as I became acquainted with Mach's works, I at once recognized in him a kindred spirit, and my admiration has only increased by personal acquaintance. I am proud to count him among my dearest personal friends. There are no doubt differences between Mach's views and mine, but they are due, so far as I can see, to Mach's (in my opinion exaggerated) anxiety not to lose in his science from under his feet the *terra firma* of concrete facts.

Professor Mach looks, so far as I can see, with too much suspicion upon theories in every form, and compares them to the scaffolding of a building in erection. The scaffolding has to be taken down, as soon as the building is completed. He further criticises the mechanistic view, —that theory which would resolve all the different sciences into mechanics,—as insufficient and one-sided, a proposition to which I agree but not without considerable modification and for other reasons than his as well as with different objections.

I had some controversies on these points with Professor Mach, but I have not succeeded either in converting him to my view, nor have I been convinced by his reply. I had hoped at any rate for a mutual understanding by which our disagreement would either be reduced to verbal differences, or its source and significance be discovered, but in some way or another I have not succeeded, and our readers might deem it an open question whether there are points in which I have misunderstood Professor Mach, or whether in spite of all agreement, we face a radical difference in our philosophical conception.

Now Dr. Kleinpeter, one of the most ardent and most accomplished disciples of Professor Mach, presented a condensed statement of Professor Mach's monism, in the

April number of *The Monist*, and I find that in pointing out the uniqueness of Professor Mach's standpoint, he includes among others my own philosophy as noticeably different from his. Whether or not this is so ought to be decided by Professor Mach himself, but being anxious to understand him, as well as to point out why and how I differ from him, I wish to devote to this important subject a few comments.

I have always endeavored to work out a philosophy that should be objectively acceptable to all as much as is any science. Philosophy as a science, or in other words the philosophy of science, is the great desideratum of the present age. In order to attain my aim I have carefully endeavored to eliminate the personal equation which philosophers so easily introduce into philosophy by their ambition for originality. At the same time I have tried to understand other philosophers, not in their errors according to literal interpretations, but in the truth which they intended to bring out. The intention of a philosophy is its spirit, and many drawbacks in the systems of the past are due to awkwardness, perhaps also to the fact that standpoints have been taken in contrast to errors of their age, and I find, when trying to be just toward other philosophers, that there is more agreement in the philosophical world than is generally thought. Even in my present differences with Professor Mach, I still feel the confidence that we mean the same, and where I may appear radically opposed to his views, especially as understood by Dr. Kleinpeter, I am convinced that Dr. Kleinpeter is only not sufficiently familiar with my exposition, and that he misunderstands it because he does not fully appreciate the object which I have in view, and which, so far as I can see, is only more comprehensive than are Mach's expositions, and will help to explain his theories on the economy of thought. On the other hand, Dr. Kleinpeter insists,

as it seems to me, more vigorously than Mach himself on those points which I deem the weak spots of Mach's views.

Dr. Kleinpeter makes too much of a passage in Mach in which, with reference to the difference between the reasoning of the philosopher and the scientist, he speaks not without irony of the fortunate position of the philosopher who possesses unshakable principles, while the naturalist considers even his best-founded views as provisional.

Dr. Kleinpeter claims it as quite original for Mach that to him there is only one kind of reasoning. Though there are a few philosophers who think that there is a difference between philosophic and scientific cognition I do not think that either Aristotle or Kant would have made that distinction; and as to myself I will in this connection call attention to a controversy I had with Professor Jodl on this subject* in which some years ago I insisted on the very same point, and claimed that there was no philosophical reasoning different from that of the scientist. Like Mach, I go further and claim that the scientist's view is nothing but common sense only more refined by exactness and punctilious attention to detail. More than that, all thinking is but the conscious tracing of the processes which build up the subconscious foundation of our mind, being kin to other natural phenomena not only in the animal world but even in inorganic nature.

Dr. Kleinpeter italicizes the statement that "Mach's monism is not a monism of system, but a monism of method." If this is meant in contrast to all other conceptions of monism, including my own, I wish to call his attention to the fact that this is an important point I have been insisting on since I have become a defender of the unitary world-conception. I will only make one quotation

* *Surd of Metaphysics*, pp. 101-115. Republished from *The Monist*, II, pp. 235-238.

which I select from my *Primer of Philosophy* (Introduction, p. 4) where I say in almost literal agreement: "Monism is not a finished system, but a reliable plan for a system." I have always rejected all those monistic conceptions which would establish a unity of the world by reducing it to one abstraction, either of matter, or of spirit, or of any other generalization. I have taken pains to explain that all these abstract ideas are not realities, but thoughts (abstract generalities), and that the unity of the world has to be derived from that obvious feature of experience which allows the methodical systematization of knowledge. Whether or not the world consists of one substance or possesses also an external unity, is another question of which I deem an affirmation probable but as yet unproved. The main thing is that there is no duality in the conception of the world, and all truths must finally form one consistent system of truths. If there is any difference between Mach and myself, I might claim having paid even more attention to this particular point, and having more vigorously insisted on it, than he.

Professor Mach's monism is the result of his methodology, and his methodology is based on the experience that science is economy of thought. I agree perfectly with him on this subject, and I believe that he has not had a more appreciative reader of his expositions than myself. He has treated this particular subject with an unprecedented mastery, yet it would be a mistake to say that he is the only, or even the first, scientist who has recognized this point. Mr. Thomas J. McCormack has collected a number of remarkable passages from Adam Smith on the very same subject* which prove that consciously and unconsciously other people have had the same thought. It is perhaps natural, and most assuredly interesting, that an economist should be more appreciative of the value of

*"An Episode in the History of Philosophy," *The Open Court*, IX, 4450.

economy of thought than philosophers, but it is sufficient to prove that the idea is not as unique as Dr. Kleinpeter thinks, although I am fully convinced that the way in which Mach handles the subject proves the originality of his mind.

While I have no objection to Mach's description of science as economy of thought, I would hesitate to say that it is sufficient as a definition, because science is a correct (or adequate) description of facts in their essential features. Exactness, correctness, adequacy, truth, or whatever you may call it, is the main thing, and comprehensiveness comes in second as a natural consequence whenever the essential features have been rightly understood. Economy of thought again is due to comprehensiveness; and so in our conception economy of thought, which undeniably is a significant characteristic of science, can by no means be regarded as a sufficient description of science, or even its most essential quality.

We are told by Dr. Kleinpeter that "it is characteristic of a system that it begins in some slight self-evident proposition and descends from these to particulars," and that "Mach's method" is "exactly the reverse." Since the term "system" is also meant for my conception of monism, I wish to call Dr. Kleinpeter's attention to the first chapter in my *Fundamental Problems*, on "Ontology and Positivism" in which I point out the contrast of my monistic positivism to Hegel's ontology. While Hegel starts from the abstract and comes down to the concrete, I start from the concrete and explain the nature of the abstract as having risen from concrete facts. And our abstractions have been invented for nothing else (as Schiller once declared) than to give us a survey over the domain of facts.*

The difference between myself and Professor Mach

* For the elucidation of this point, I translated and quoted Schiller's splendid little poem "The Metaphysician" in *Fundamental Problems*, p. 77.

as to the part which economy plays in the realm of thought is mainly this: that while Professor Mach appears to rest satisfied with using it as a principle that has so far worked well in experience, I try to explain why economy of thought is possible at all, and my explanation is based on the idea that theory is not a purely subjective device to deal with experience, but that there is a feature in experience itself which justifies the formulation of theories. This feature is conditioned neither by energy nor by matter (which are the abstract terms for the concreteness of the world as experienced by resistance), but it is of a purely relational, i. e., a purely formal, nature. The purely formal is characterized by an absence of concreteness, a negative feature which, however, (as is the case with all negative magnitudes) is not without a positive application. In my articles on mathematical space I have defined it as "any-ness," which implies generality, and experience proves that the generality of the purely formal can be relied upon in the domain of concrete objectivity. Accordingly the purely formal is not merely a matter of method, it is not purely subjective, but must be a feature of the objective world.* It explains why there are uniformities. In other words the purely formal (Kant's *a priori*) is not as Kant says purely "ideal," but it is also objective. Numbers, curves and other *a priori* constructions can be employed as systems of reference for determining features in analogous instances of experience.

This is a justification not only of the objectivity of form and formal relations, but also of their correct representation in the purely formal sciences (Kant's *a priori*). It is more than likely that Professor Mach would object to the term *a priori*. Nevertheless he accepts confidence in it for *a priori* means nothing but beforehand knowledge, i. e.,

* For details I must refer to the articles in question, "The Philosophical Foundation of Mathematics," *The Monist*, XIII, 273; "The Foundations of Geometry," *ibid.*, 370, 493.

the possibility of knowledge in certain lines of argument by reflection, pure thought, mere theory (call it by whatever name you please) even before we have had an experience thereof. Such is Kant's own explanation as stated in the beginning of the *Critique of Pure Reason*.

Professor Mach (as quoted by Dr. Kleinpeter) speaks of the essence of science as "a means by which we are spared direct experience." That is an unequivocal recognition of the *a priori* as a working principle.

There are two kinds of theories, first such elucidations of a group of unexplained facts as render it intelligible by comparing it to another group of facts that is well understood. The theory of an electric fluid is a good instance. Such theories are mere scaffolds which (as Mach suggests) will have to be taken down as soon as we know the actual state of things. They are mere similes, helpful so long as we know no better, but they may become hindrances to progress if not distinguished from facts. However, there is another class of theories which consist of uniformities, viz., generalized descriptions of groups of facts, and they are not merely temporary scaffolds, they are the real stones of the building of science itself.

According to Professor Mach there is no difference between purely formal and material, between *a priori* and *a posteriori*, and I shall possibly agree with him in the sense in which he means it, for I do not deny that ultimately everything is derived from experience. Yet there is a contrast between the purely formal and the material; there is a difference of method between purely mathematical investigations and chemical experiments. Much depends on words, for we may or may not limit the term "experience" to sense-experience only.* The truth remains that all mathematical and logical truths are the results of an inner experience called reflection, and in performing purely

* Compare my *Primer of Philosophy*, p. 26 ff.

formal operations we omit all reference to either matter or energy, the main features of objective reality, and limit our attention to the purely relational.

While purely formal thought constitutes a field of its own, I have insisted on the fact that it does not stand in contradiction to experience. Sense-perception and the purely formal sciences are ultimately derived from the same source. The latter are purely mental constructions, yet the principles and general conditions of mathematics, including geometry and algebra, logic, etc., have been quarried, as much as sense perceptions, out of the mine of experience. There is nothing that has not, directly or indirectly, been derived from experience, but the characteristic feature of the purely formal sciences in contrast to the natural sciences resting on sense-perception is exactly this,—that the former are purely mental constructions built up in the abstract domain of anyness. I grant that mathematics is absolutely true only in the field of its own premises (mathematical space), but there is in it a feature which makes it universally applicable, and we have only to modify it by considering the special conditions to which it is applied.

Further, does not Dr. Kleinpeter exaggerate the significance of Mach's proposition that "sense-perceptions, not objects, are the subject-matter of the scientist?" Is not the definition of object as a bundle of sense-perceptions widely accepted? The first sentence in the chapter entitled "Definitions and Explanations" in my *Fundamental Problems* (p. 254) states the same truth as follows: "The data of experience are perceptions." It is quite obvious that the difference between the psychologist and the naturalist is merely, as Mach says, a difference of standpoint, or as I would express myself, a difference of the object in view, a difference of purposes.

In spite of these agreements between Professor Mach

and myself I know of some differences—especially those concerning which we had some controversy. Professor Mach regards the whole of reality as sense-perception, and deems the distinction made between objects and sense-impressions inadmissible. To him sense-impressions contain the whole of reality, and science has nothing to do but to analyse and elucidate sense-perceptions. It seems to me that there must be here a difference of nomenclature, and I would think that Professor Mach in speaking of the sense-perception of a star, includes with it the star itself and the whole immeasurable depth of celestial space which according to our scientific knowledge the light of the star has to travel. Professor Mach has informed me that such is not his view. His idea of sense-perception is simply sense-perception and nothing more.

Professor Mach explains the origin of his views in a footnote on page 23 of his *Contributions to the Analysis of the Sensations* where he says:

"I have always felt it as a stroke of special good fortune, that early in life, at about the age of fifteen, I lighted, in the library of my father, on a copy of Kant's *Prolegomena zu jeder künftigen Metaphysik*. The book made at the time a powerful and ineffable impression upon me, the like of which I never afterward experienced in any of my philosophical reading. Some two or three years later the superfluous rôle played by the "thing-in-itself" abruptly dawned upon me. On a bright summer day under the open heaven, the world with my ego suddenly appeared to me as *one* coherent mass of sensations, only more strongly coherent in the ego. Although the actual working out of this thought did not occur until a later period, yet this moment was decisive for my whole view. I had still to struggle long and hard before I was able to retain the new conception in my specialty. With the valuable parts of physical theories we necessarily absorb a good

dose of false metaphysics, which it is very difficult to sift out from what deserves to be preserved, especially when those theories have become very familiar to us."

Mach's book *Contributions to the Analysis of the Sensations* is the result of the experience here related. If the whole world consists of sensation, the work of science can only be an analysis of sensations.

Without finding fault with Professor Mach's views, I would say that I prefer to state the same truth in a different way. Professor Mach speaks of "sensations" as "the elements of the world," while I call "sense-perceptions" "the data of experience." I do not hesitate to say that the data of experience (i. e., the sum total of our sensations) is the basic portion of our subjective existence, and the rest of it, our ideas, abstract thoughts, etc., is a mental construction built from the material furnished by sensations. The domain of thought has been worked out to serve as a picture of the objective world, or in other words it is meant to denote the conditions which determine the different states of our subjective existence. Professor Mach thinks that sensations alone are real and that our ideas are purely mental symbols, but I beg to differ. I am perfectly aware of the subjective nature of our mental constructions, but I claim that they have objective validity. They are not purely subjective reconstructions of what we call things and the interrelation of things. I endorse Mach fully when he describes our thoughts as an imitation or remodeling of the facts (*ein Nachbilden der Thatfachen*) but I would not limit the meaning of the word "fact" to sensations, which alone are said to be real and the elements of the world. I would include under the term also and especially those objective factors which we assume to be the external causes of our sensations. Whether or not things are such as we conceive them to be is not the question here. We only say that things as they appear to our

senses give evidence of a reality not ourselves which we call objective; and our mental picture of this reality may be correct or incorrect, true or false, adequate or inadequate, according to our power of verifying our anticipations. If I see an after-image and try in vain to take hold of it with my hand, I conclude that the after-image is an illusion, which means that I deny its reality. If I have a wrong idea concerning the nature of certain things, my anticipations will be disappointed, and I shall have to grant that I was mistaken. But if my anticipations do not disappoint me, the object is called real. If my calculations based upon exact observations prove reliable, I am entitled to think that they were correct. Truth is adequacy of representation with reference to the thing represented, and the only test of truth to be had is a justification by experience.

One characteristic feature of experience is a general consistency of facts which may popularly be expressed in the statement that nature is uniform. The uniformities of nature, commonly called natural laws, do not contradict one another.

Mach's definition that sensations are "elements of the world" is true from the subjective standpoint, but our own experience teaches us that the subject originates and passes away. The elements of the subjective world are not the elements of the objective world, though we may say that the elements of our knowledge of the objective world are sensations, or better sense-impressions, made upon the subject by an unknown reality. Mach's definition of "sensations" as "the elements of the world," is a misnomer; he ought to define it as "the elements of *our* (i. e., the subject's) world."

We would further say that the data to be analysed are not exactly sensations but perceptions. It is a well-known psychical truth that man is not conscious of the sense-

element of his sensations, but of the result such as it appears when worked out by the mind. This result of sense-impressions is called perception. If I see a sparrow seated on the window sill, I do not see a little brown speck on my retina, but I see a gray bird; in other words, I am conscious of the result and not of the elements into which a psychological and physiological investigation analyses my perception. And this is so true that our sense-perceptions are sometimes vitiated by ideas associated with kindred sense-impressions. Hallucinations or counterfeit perceptions are produced with such vividness that the sensation is forever afterward adulterated by its association, so as to render a reliable analysis of its recollection absolutely impossible.

I have never lost sight of the truth that not things, but our perception of things, are the data of experience. To me this proposition is a tautology, for it simply means that the world of our subjectivity is subjective. But for that reason I would not say that the world itself is subjective too. While "*our* world" is made up of sense-elements, "*the* world" is different, and in contrast to subjective existence we call it "the objective world."

It is a traditional fault of idealists (who, however, had better be called subjectivists) to identify the subjective world with the entire world including its objective aspect. One of these idealists is Schopenhauer, and through him I became for the first time intimately acquainted with idealism. Idealists as a rule when understanding the truth of the proposition that our world consists of sensations, forget that the idealist view is one-sided and must find its completion in a proper comprehension of the nature of the objective world.

The contrast is well described by Schopenhauer, who characterizes Goethe as a realist (or we had better say "objectivist") incapable of understanding the subjectivism

of Schopenhauer's idealism. Schopenhauer met Goethe at Weimar, and mentions the following incident:

"This Goethe is so entirely a realist that he could not get it into his mind that objects as such existed only in so far as they were conceived by the thinking subject. 'What,' said he once to me, gazing at me with his Jupiter eye, 'light should only be here in so far as you see it? No sir. You would not be here if the light did not behold you.'"

Obviously both Schopenhauer and Goethe are right, and each one expresses one aspect of the truth. Objects, *qua* objects, are mere bundles of sensations and the objective world as it is conceived by man's mind is a picture woven of sensation and thought. So far Schopenhauer is perfectly right, but that something which is represented by these sensations is not a mere dream. It is what is commonly called reality or the objective world, and this objective world is the foundation from which the subjective world is a mere temporary and transient reflection. Accordingly, Goethe is right (just as much as Schopenhauer) when he contends that man and his eye would not exist unless the light did behold him and thereby had produced his vision. Schopenhauer means by light a psychological function, while Goethe means an objective process, viz., the ether waves which produce those wonderful color sensations on our retina. The eye would never have developed in a world without ether waves.

That Goethe was neither so one-sided nor so philosophically crude as Schopenhauer thought, appears from his well-known aphorism:

"Were not the eye to the bright sun akin,
It never could the light see shine,
And did not God dwell thus our soul within,
How could with rapture thrill us the divine?"

"Wär' nicht das Auge sonnenhaft,
Die Sonne könnt' es nie erblicken.
Läg' nicht in uns des Gottes eigen Kraft,
Wie könnt' uns Göttliches entzücken!"

I am faced by the dilemma that either Mach has strained a point and we must not take him seriously, or that he is an idealist or, as we would say, a subjectivist.

The other point where I cannot follow Professor Mach is his objection to mechanicalism. I must confess that I myself am not a supporter of the mechanistic theory of the world in the sense in which Professor Mach criticizes it. There are philosophers and scientists who believe that the whole world can finally be explained by matter and motion, and that all the sciences can ultimately be resolved into mechanics. This proposition in my opinion can not be maintained. Still I believe that all motions can be mechanically explained. The mechanical theory applies strictly and without exception to any process in the objective world that is a change of place, but it does not apply to other events such as belong to another domain of generalization. There is for instance no way to explain mechanically a feeling, or an idea, or a sentiment. I can explain the physiology of sensation as a commotion in the sense organs and nerves, but not the feeling; and the simple reason is that feelings and ideas are no motions, and can not, in consequence, find a mechanical explanation.*

Mach confesses that a perusal of Kant's *Prolegomena* made a powerful impression on him, but I do not know how it influenced him in the formation of his own thought, for nowhere in Mach's writings have I found a discussion of Kant's problem of the *a priori*. To Mach there is no *a priori*; to him the purely formal sciences are as empirical as physics and the other natural sciences. And yet he recognizes the existence of the *a priori*, in that he grants that by science we are spared direct experience. How is it possible that we can know anything if not through direct experience? Mach discovers that it is possible, and I have undertaken to show why it is possible.

* For further elucidations see for instance *Soul of Man*, pp. 16-22.

This world of ours with which we become acquainted by experience is a peculiar mixture of two features which seem contradictory. It consists of innumerable sense-impressions picturing as many events or objects, all particular, all individual cases, each one different from the other, a wonderful chaos of single items, an unlimited pluralism. And yet this chaos is amenable to classification by similarity, sometimes even sameness of form. We meet with classifiable types many of which constitute systems of classes and subclasses, like drawers containing boxes, all arranged in logical order as genera, species and subspecies. This systematization of experience is not a human invention but is part of the world itself. It is not an artificial device of the scientist, but it is the natural growth of mind which develops as unconsciously as a tree blossoms and bears fruit. Its regularity is due to the same norm that conditions the regularity of a snow crystal or the regularity of the petals of a flower.

The immediate outcome of this classification results in the development of man's mind in the faculty of generalization, implying a wonderful economy in the household of thought and the almost magical ability of anticipating experience. This is the problem of before-hand knowledge commonly styled the *a priori*.

The problem of reason, which is identical with the problem of the nature of universals, as well as the *a priori* was well formulated for the first time, but not correctly solved, by Kant. To him reason, i. e., the whole machinery of purely formal thought, in other words, all *a priori* knowledge of any kind, is "ideal," i. e., our categories of thought and also our conceptions of time and space are mental constructions, while the data furnished by experience (our sense-impressions) are real. This is the climax of nominalism which denies the reality of universals and looks upon them as mere names (*nomina*) or, as scientists to-day

would say, "mere theories." There is nothing real in them save the breath of the voice (*flatus vocis*) that utters them.

Nominalism is the denial of an old and inveterate error of science, viz., the thingish reality of universals, which would be well characterized as a belief in philosophical mythology. We have seen what a prominent part the universal plays in the formation of man's mind, and we can not wonder that universals (especially those of practical importance) have been deified as Zeus and Athena, as Poseidon, Hades and Persephone, etc., and even the sages of antiquity who recognized at once the incongruities of mythology which treated universals as persons, nevertheless looked upon them as realities not unlike moulds which existed somewhere in the workshop of God. Such is Plato's doctrine of ideas which exist above time and space in the realm of eternity. The mediæval school that insisted on the reality of universals is called "realism" (which of course must be well distinguished from modern realism) and, establishing itself firmly in the Church as well as all great institutions of learning, it succeeded in crushing nominalism. While victorious realism became ossified in dogmatism, nominalism led a miserable existence among heretics, but proved the more vital of the two, leading up to modern science with its denial of universals in any shape.

Kant drew the last consequence by relegating all theory, anything universal and *a priori*, to the thinking subject. His idealism does not deny the reality of the objective world but claims that its order together with all laws of nature has been transferred to it by the thinking subject. Form and formal laws appertain to the latter not the former, leaving the former, the objective world, the object, the sum total of things, in itself unknown and unknowable.

Kant does not deny the objective validity of the purely formal; he only denies its reality. To him, time, space and the categories, including causality, are merely subjective,

but being inalienable features of the thinking subject, they are to every thinking subject universal and necessary, so that we can not help viewing everything through these mediums.

Mach's position is similar in many respects. He denies the reality of universals and suffers theory merely as a makeshift, as a scaffolding, temporarily erected for tentative simplification of a description of facts. Our sense-perceptions alone are real to him. Everything else, as for instance the concepts of atoms and other notions of physics, is to him a device to facilitate an analysis of sense-perceptions and to trace the interconnection of their elements.

In criticism of these views I claim that while nominalism was right in objecting to the doctrine of realism which hypostatized universals, realism was right in insisting on their reality. In other words, while our formulation of universals is subjective, there is an objective feature in the world which corresponds to them and so justifies their construction. This objective feature is form.

Form is typically objective, and it is subjective only because the thinking subject is at the same time an object moving about, like all other objects, in the objective world. The subject has constructed systems of conceptions, analogous to the forms of the surrounding world. Hence their agreement is a matter of course. There is no need of transferring them to the objective world; for they were there, before we were, and our mind together with its reason and purely formal sciences is a result of their presence in the cosmos of which we are a part.

The laws of form are universal, and mind develops (as everything else) on account of them. The cosmic order is due to the regularity of form, and the ideal construction of the laws of form in the shape of arithmetic, geometry, logic, etc., are simply a tracing of necessary results derived

from actions (such as counting and measuring) in the domain of anyness.

By anyness I understand a mental field emptied of all particularity so that its abstract emptiness is homogeneous in any of its parts and a sameness prevails throughout for any construction. In reality, i. e., in the aggregation of things, viz., the objective world, there is no such a thing as absolute homogeneousness, for every point in space and time is different from any other, and even if we assume that there was a time in which the aboriginal world-stuff was homogeneous, every particle of it was individual and different from all others, by position as well as by being itself and not its neighbor. In a certain sense you may say that anyness is an assumption of science, or if you prefer, a fiction, but there is a feature in reality that corresponds to it which we call form. It is understood that there is no form in itself, any more than there is matter in itself, or energy in itself, or anything in itself. But form as a feature of reality is as real as matter and as actual as energy. Considered by itself (which can be done by abstraction) it is empty, i. e., void of particularity, and thus it possesses that indifference which makes it applicable to any case, but the very anyness of this empty abstraction constitutes its great use in the domain of thought.

Kant's fault is that he identifies "the ideal" (i. e., the domain of thought, forms or ideas) with the subjective; hence his idealism is after all (in spite of his protests) subjectivism. Still he recognizes the validity of the laws of pure form in experience, and truth is to him not, as to the realist, an adequate representation of the thing but its consistent adaptation to the mind. Nietzsche, however, out-Kants Kant. His philosophy is nominalism with a vengeance. Truth is altogether abolished. It is denounced a fiction, nay a fraud. Logic becomes mere pedantry; consistency of thought, foolishness; and reason, a farce. Nor

does Nietzsche shrink from the last application of his denial of truth, for with its abolition he denies all difference between good and evil, right and wrong, and the higher man is not he who is nearer to truth and actualizes it in his life by doing right, but he who possesses more brute power and uses it by ruthlessly treading his fellow beings under his foot.

Is Mach's philosophy truly a mere revival of nominalism? We would be obliged to say so if it is a matter of principle with him that all theory stands condemned as mere fiction whose utility is purely temporary.

Mach points out that the method of explanation is by resolving the unknown into terms of the known, thus rendering the known familiar to us. This is true to some extent, but not altogether. The savage is familiar with the fact that fire consumes sticks of wood and sees no miracle in their disappearance. But the scientist can not be satisfied with mere familiarity. He weighs and counts and wants everything that makes its appearance or disappearance accounted for. He is not satisfied until he knows what has become of the sticks that have been burned and how the ashes originate. The scientist looks upon the world as a system in which the sum total of substance* and energy is constant, while the form is subject to change. He deems an event unexplained until he can trace the transformation that has taken place.

Transformations are changes of place, or motions. Therefore the ideal of science will always be to reduce all physical phenomena, all the transformations that occur in space, to motions, and thus we try to render molecular

* We say substance, not matter as is customary when speaking of the law of the conservation of matter and energy. By matter we now understand bodily reality analyzable into its chemical elements, and the term is frequently used in contrast to ether. Naturalists have of late been forced to the conclusion that matter is not eternal but that it is formed by condensation from a thinner substance which we have good reason to identify with the ether. The word "substance," being more general than "matter," would be more correct in the present connection.

changes comprehensible by thinking of them as minute motions. We do so because we can not help it, for in fact we can not even conceive of a transformation of anything except by a new adjustment of its parts which involves a change of place or motion. Mach looks upon this ideal of physical science as illegitimate and as an illusion. He believes that we happen to be best familiar with motions and therefore only mechanical explanations are most satisfactory to us. But if we assume that we were better familiar with electrical phenomena or with some others due to molecular changes, we would try to explain mechanical processes by comparing them to electrical phenomena.

There is a truth in Mach's proposition; it is this, that the unknown becomes more familiar to us by association with the known. We become accustomed to it as when a stranger is introduced to us by a friend. But to be familiar with an occurrence and to comprehend it are two different things. A full comprehension comprises not only a knowledge of all the details of a transformation, the description of a series of causes and effects, but also the reasons (commonly called laws of nature) which sum up the salient features of a whole class of phenomena in a general formula.

When Mach says there are no causes, and when Kirchhoff drops the term *Ursache* from his definition of the science of mechanics, they do so because they have in mind a wrong conception of cause. The words cause and reason have their very good use in language, but since time immemorial philosophers have confused both terms, and have mystified the world with their errors. Such phrases as "*causa sui*," "first cause" and "final cause," are evidences of the general confusion. By *causa sui* Spinoza means the most comprehensive reason which needs no explanation; he does not mean a cause at all. "First cause" is a misnomer for "ultimate *raison d'être*," and "final

cause," for "purpose." Kirchhoff was satisfied to define mechanics as a terse and exhaustive description of motions,* and he is right; but his descriptive formulas of typical cases are exactly the reasons why a certain motion takes place in such or such a way. Galileo's law simply formulates the salient feature of the rate of acceleration in falling bodies, and Newton's law describes the function of gravitation. In other words laws of nature are (as Clifford said) uniformities.

And among the uniformities of nature, the mechanical descriptions have not accidentally become the most important ones which merely appear to be most helpful to us because we are most familiar with them. I can imagine that there are sentient beings in whom electrical or chemical senses predominate. The senses of touch, motor sense, and sight, are prominently mechanistic, being quick to observe and trace motions and mechanical changes of form. In dogs and fishes the sense of smell is marvellously well developed, and there might be animals who rely mainly on, or are adapted to perceive, thermic, electric, or other phenomena. Yet I venture to say that no chemical or electric sense could out of itself and without the assistance of either sight or motor sense have developed mind and reason. Man became man because he moved about, because he observed motions and learned to adjust his own motions. The mechanistic conception of processes renders them comprehensible. The world would remain obscure to us if we had to classify things according to odors. In fact living beings begin their career as animals of smell, but in the progress of evolution the eye and the hand develop, which organs serve best the mechanistic function of comprehension, while the olfactory lobes degenerate. I am prepared to say that reason is, if not

* See the author's *Grund, Ursache und Zweck*, Dresden, 1881; *Fa mental Problems*, pp. 88-91; *Primer of Philosophy*, pp. 138-143.

together, yet most assuredly in a great and indispensable part, the product of the mechanistic interpretation of nature.

Professor Mach is quite positive in his opposition to the mechanistic conception of the world, but I have never been convinced by him.

I grant that a mechanical description of physical happenings is only a one-sided method of comprehending reality. Nay, I would go further and say that any scientific treatment is insufficient to exploit all the values of experience. Besides the intellectual interpretation of the world, we have others that can not be determined either in the balance or by the tape measure. The mystic's point of view is under certain restrictions quite legitimate, and at any rate the artist's interpretation is recognized as proper even by the larger number of scientists. However, though other viewpoints have their right, and though in their way they are apt to cover features of reality which are inaccessible to an exact valuation or computation, the methods of science will always remain indispensable and are unique in their way.

While I grant that universals are mere generalizations, and theories mere devices of science to render groups of phenomena intelligible, I yet insist at the same time that there are features in the objective world which correspond to them. Plato's conception of eternal types (the Platonic idea) is not wrong, if we make allowance for some mythological expressions. So, generally, man's conception of truth though a mental picture reflects, in so far as it is correctly worked out, an objective feature of reality. The same holds good of space and time and the purely formal sciences. Our space and time conceptions are mental constructions and some of their features are purely mental, but the relational is a factor in the objective world, and indeed it is the main factor in all processes of transforma-

tion. Any one who will take the trouble to apply my method of interpretation to the history of human thought, including the history of religion, will find much truth in error, for what at first sight seems like a string of superstitions becomes a systematic approximation in exactness of statement, and so we learn that the old chaff of tradition was not without its grain of truth.

If I appear in contrast to Mach in a reactionary light, I have held to my view not without weighing the pro and con of his standpoints, and with all due reverence to Professor Mach's prominence and fame, I must continue to hold my own, not because they are my own, but because they include all the truth propounded by Mach. I know why Mach halts, for I go beyond him and explain his views.

The points where I seem to differ from Mach (so far as I understand the situation) are exactly a recognition of the truth which will set his most helpful thoughts into a clearer light. My solution of Kant's problem will explain Mach's principle of the economy of thought and show how economy of thought originates, and why it is valid in experience, i. e., why it can be applied and relied on as a method of scientific inquiry.

Mach is a great scientist, and it is peculiar to him that unmindful of others he has pursued his own way even to isolation. As a thinker he stands by himself, and there is a gulf between him and his predecessors. Wherever his thought coincides with the thought of others, we may be sure that he arrived at the result in perfect independence, and Kleinpeter goes so far as to describe his views as contradictory to the general traditions and makes the contrast more pointed than it really is. I see in Mach a necessary and indeed healthy and extraordinarily successful phase in the development of the philosophy of science. While Kleinpeter emphasizes Mach's position in contrast to his predecessors too much, because he fails to see that there is

a truth also on the other side, I believe that a recognition of the truth as seen from the other side will lift Mach out of his isolation and will set his favorite ideas in a worthy frame.

* * *

It seems probable to me that Professor Mach will deem my philosophy reactionary. When he sees that I recognize some truth in views which he has discarded, he will think that I have fallen behind, and march in the rear of progress. This at any rate appears to be the impression which my writings have made on Dr. Kleinpeter. I can calmly leave the decision to posterity, and will only say here that for similar reasons I appear reactionary to many freethinkers who blame me for not joining their chorus in denouncing all religion as superstition. It is natural that he who endeavors to avoid one-sidedness will appear over-conservative to the radicals and over-radical to the conservatives.

I am the most radical among the radicals, and yet I am more truly conservative than most of the leading orthodox churchmen. I recognize no limitations, I owe no allegiance and feel under no obligations: I am willing to take the consequences of truth whithersoever it may lead. I go beyond the agnostic, who in my conception is a half-hearted thinker that does not care to be of his own opinion. He denies but does not endorse his denial and leaves it an open question, throwing the burden of responsibility upon his opponent, daring him to make the affirmation. What the agnostic deems unknowable is non-existent. There is not *such a God, no such soul, no such immortality* as he questions. But while I myself frankly deny the mythology of our traditions both in science and religion, I am not prepared to discard their meaning. I would teach mankind not to abandon their ancient conceptions of truth, but to reinterpret them, or to restate them, unencumbered with

mythology. Myths are truths poetically expressed; but negations are void of truth. The thoughtless have always found it easier to believe in the letter than in the spirit and so superstitions were unavoidable. Negations, doubt and unbelief are desirable for the sake of preparing reforms, but progress is not in them. Progress moves in affirmations, even though they are temporarily dressed up as myths and act as superstitions. The myths and parables of the past are preliminary surrogates which are insufficient approximations of the truth, and so the ideas, God, soul and immortality will remain, but the current views will have to be replaced by conceptions that are better, nobler and truer.

What is true in the history of religion is true also in the evolution of science. The old views are not quite so useless as they may appear to the iconoclast of radical reform.

EDITOR.

THE FUNDAMENTAL CONCEPT OF THE PRIMITIVE PHILOSOPHY.

THOSE who have undertaken to set forth systematically the essential features of the religion of undeveloped man have commonly made much of the anthropomorphic character of the primitive *Weltanschauung*. Man's earliest and most natural hypothesis concerning the causes of the phenomena presented in his experience was—we are often told—that the action of external objects upon himself was referable to the same kind of causation as that which he knew to be the explanation of his own action upon external objects; namely, to conscious volition. He is therefore represented as instinctively projecting his own personality and consciousness into the things and forces around him; and primitive religion is described as involving essentially the reduplication of the directly known society of visible human persons by a less directly known society of more or less superhuman persons, present in the objects and agencies of nature; to which, of course, must be added the innumerable company of ghosts. Thus the late Dr. Brinton has declared that “the psychic origin of all religion is. . . the assumption that conscious volition is the source of all force, and that man is in communication with it.”¹ And Guyau has insisted that “the religious sentiment has its beginning in the world at the moment in which the idea of mechanical necessity gives

¹ *Religions of Primitive Peoples*, p. 47.

place to the idea of a sort of moral and social reciprocity—at the moment in which there arises the conception of a possible *exchange* of feelings and even of desires, a kind of sociability, between men and the cosmic powers, whatever they may be.”² It was, of course, Mr. Tylor who first made widely familiar, and illustrated by a wide range of examples, the view that the dominant characteristic of early thought was the belief in the universal animation of nature, that “the operations of the world seemed [to primitive man] to be carried on by other spirits, just as the human body was held to live and act by virtue of its own inhabiting spirit-soul.” Since the publication of Tylor’s *Primitive Culture* (1871) the theory that the ruling hypothesis by which the savage explains his experiences is a sort of anthropomorphic animism, has been an accepted commonplace of ethnology. Even the small group of theorists who follow Mr. Spencer and Mr. Grant Allen in tracing all spirits back to ghosts, agree, at all events, in conceiving the religion of the natural races as consisting chiefly in transactions between persons—between living persons and deceased persons—under the forms natural to personal relationship, i. e., propitiation, entreaty, bargain, alliance, friendship or cajolery.

Now this anthropomorphic aspect of savage thought is, of course, undeniably a real aspect. But with the steady accumulation of fuller and more accurate ethnographic material in recent years, it has become increasingly evident that there is another still more important and pervasive—and perhaps earlier—element of the primitive philosophy. This element, however, though more or less casually recognized by several recent writers on primitive religion and folk-lore, has been far less adequately emphasized and less systematically set forth than has the theory of animism. It has hitherto, for the most part, been given

² *Irréligion de l'avenir*, p. v, vi.

neither the definiteness nor the degree of importance that it can actually be shown to possess in the savage man's scheme of the universe. That scheme, though it is, of course, full of the oddest self-contradictions, is no mere haphazard collection of unrelated superstitions; it has a curious logic of its own, which it is not impossible to unravel. The present paper is the first chapter in a study which undertakes to set forth, with rather more system and connectedness than has elsewhere been attempted, the nature, bearings, and diverse applications in custom and rite, of the central conception of early human thought, so far as that conception is brought to light in the religious and magical vocabulary and practices of savage races within historic times. This study is less an attempt to add to the sum of ethnological data, than to correlate and bring out more fully the significance of certain data that are, for the greater part, familiar to ethnologists.

For the sake of clearness, let me, at the outset, lay down somewhat dogmatically, and somewhat too categorically, what seems to be the essence of that central conception in the savage view of the world; the evidence which shall verify, and the qualifications which must hedge about, the theory, will be better understood if the broad outlines of it are first of all made plain. There is, I desire to show, a category which is yet more fundamental in the savage mind than that of personality. Behind all their anthropomorphism there is in the thinking of many or most races at this stage of culture, an idea of the nature of things and of the causation of events, which is distinctly impersonal and quasi-mechanical. With something approaching uniformity we find, as the underlying and all-controlling preconception in the thought of savages, a belief of which the following propositions express the essential features: that there is present in nature a diffused and inter-connected impersonal energy or vital force, some *quantum*

of which is possessed by all or most things or persons; that the amount of this energy is more or less fixed or limited; that any unusual, striking or alarming power, ability or productivity in anything is evidence of the special presence of this force; that it is localized in different natural objects, or possessed by different persons, in varying degrees; that the most important property of anything consists in the amount of this energy which inheres in it; that portions of such vital energy may be transferred from one person or thing to another, and may be controlled, regulated, insulated, by various devices, usually of a mechanical sort; that contact between a person or object highly charged with this energy and one less highly charged with it will, without the volition of either, produce, as it were, an explosion of vital force highly dangerous to the weaker party, and it may be to both; that the chief end of man is to get possession and control of this force; and that the chief utility of an immense variety of rites lies in the manipulation of it.

Now much of this would be recognized by many anthropologists as roughly corresponding to ideas that are verifiably present in savage thought; but a good many, I imagine, would at the same time make two objections. It would be objected, first, that savages cannot be supposed to have conceptions either so abstract or so consequential and coherent as the foregoing propositions suggest; and, second, that, in any case, these conceptions have to do, not with primitive religion, but with one phase of savage magic. I hope, however, eventually to make it evident that though savage man does not formulate his creed in any such body of propositions, his thought, as shown both in language and customs, often follows with remarkable consistency and thoroughness, the lines of the propositions that I have set down, and that with the help of the fundamental conception mentioned, a great diversity of customs not

hitherto well explained become connectedly intelligible. And against those theorists—amongst whom Mr. Frazer seems to have placed himself—who insist upon a sharp distinction between primitive magic and primitive religion, I shall maintain that the distinction cannot, upon any good ethnological grounds, be made out, in any such fashion as to exclude the conception of “diffusive and transferable life-energy” from a determinative influence upon those beliefs and observances commonly recognized as religious, as truly as upon those customarily classified as merely magical.

It can be shown that the conception in question is the most nearly ubiquitous, most all-pervasive and most influential of the notions characteristic of early man’s thinking; a notion beside which all anthropomorphic ideas are of secondary, though still of great, significance. Among many undeveloped races the one great practical concern of the individual, the all-important business that chiefly engrosses his imagination, controls his activities and accounts for by far the greater part of his so-called religious customs and observances, is the endeavor to absorb into his person as much of this force, or to get into his possession as many objects charged with it, as possible, while at the same time insulating himself against it at those moments when its excessive quantity or unstable equilibrium makes it dangerous. In a word, the dominant preoccupation, probably, of most savages, is, not to “cultivate friendly relations with supernatural beings,” but to get into such *well-adjusted, quasi-mechanical relations with the source of supernatural energy*, that they may control the greatest possible amount of it for the benefit of themselves, their family, clan, village or tribe. And when, and in so far as, savage man does undertake to deal with his environment by setting up regular personal relations with definitely anthropomorphic nature-spirits, he is still under the

influence of the same preoccupation. Those spirits are "divine," or what Mr. F. B. Jevons calls "supernatural," chiefly because the savage finds reason to credit them with the possession of a very uncommon amount of the energy upon which all power depends. What the savage chiefly wants from them is a transfusion into himself, or his clan, of some of their energy; and meanwhile, those divine spirits are often conceived as needing an occasional, or periodical, renewal of their forces, through various revitalizing processes for the performance of which the spirits continue to be wholly or partly dependent upon man.

* * *

In any inquiry concerning the existence, importance and meaning of such a conception, the first question that it is natural to ask is whether peoples in the state of savagery can be shown to have in their vocabulary words expressing the general concept of such a universal, impersonal, communicable energy. It is this first stage of the inquiry only which is presented in the present paper. I have brought together from a number of sources, old and new, testimonies to the existence of such words in the language of at least three typical savage races—the North Americans, the races of Oceania, and the Bantu—and evidence that these words are the most important in the religious vocabularies of the peoples in question, being commonly, but erroneously, taken, by those who have written of those peoples to mean "god" or "spirit." The consideration of these linguistic usages not only establishes the existence in the savage mind of the rather abstract idea under consideration, but also throws a good deal of light upon the connotation and correlations of that idea and its place in primitive thought. I bring these testimonies together here, not because they are complete, but rather with the hope of eliciting more of the same kind

from collectors of anthropological material, and especially from philologists and from ethnographers in the field.

I. NORTH AMERICANS.

Some North American stocks have words—*manitou* among the Algonkins, *oki* among the Iroquois, *wakonda* among the Dakotas—which, as nearly as they can be reduced to any single English equivalent, appear to mean “power” or “productive energy” in the abstract, which are applied also in the concrete to any person or thing exhibiting an unusual degree of force of any sort, and which constitute the most commonly used terms in the religious vocabularies of these peoples. It was through the mis-translation of these by the English word “god,” and through the misapprehension of the peculiar abstract use of them in the singular number, that there arose the once-prevalent belief, now well known to be erroneous, that the Indians recognized a single “Great Spirit.”

I. *Dakotan Tribes.* In the case of the Dakotan word we have very clear and trustworthy information as to its use and real meaning. Thus Mr. McGee (*15th Report, U. S. Bureau of Ethnology*, p. 182) writes that among these tribes “the sun is *wakanda*—not *the wakanda*, or a *wakanda*, but simply *wakanda*; the moon is *wakanda*, and so are thunder, lightning, the stars, the winds, the cedar; even a man, especially a *shaman*, might be *wakanda*. In addition, the term was applied to mythic monsters of the earth, air and waters, to . . . fetishes and ceremonial objects, . . . many animals. . . many natural objects, and places of striking character.” “The term,” Mr. McGee goes on to suggest, “may be translated into ‘mystery’ perhaps more satisfactorily than in any other single English word, yet this rendering is at the same time too limited, as *wakanda* vaguely denotes also power, sacred, ancient, grandeur, animate, immortal.” Mr. McGee does not attempt to dis-

linguish between the essential meaning of the word and its secondary connotations: but the rather curious list of partial synonyms which he gives, affords a fairly clear indication of the nature of the idea that lies behind. Still more clearly is the meaning brought out by Miss Fletcher in her valuable paper "On the Import of the Totem Among the Omahas."³ "The foundation of the Indian's faith in the efficacy of the totem," says Miss Fletcher, "rested upon his belief concerning the nature of life. This belief was complex and involved two prominent ideas: first, that all things animate and inanimate were permeated by a common life; and second, that this life could not be broken, but was continuous. The idea of a common life was in its turn complex, but its dominating force was that which man recognizes within himself as will-power. This power which makes or brings to pass, he named *Wakonda*. The question arises, did the Omaha regard *Wakonda* as a Supreme Being? There is no evidence that he did so. . . . The word *Wakonda* seems to have expressed the Indian's idea of imminent life manifest in all things. . . . All things were distinct from man, but in the subtle bond of a common life, embodying the idea of will or directive energy, they were akin to him and could lend him the aid of their special powers, even as he could help or hinder his fellow-men. We trace the Omaha's estimate of his own will-power in the act called *W'a-shin-dhe-dhe* (*wa-zhin*, directive energy, *dhe dhe*, to send) in which, through the singing of certain songs, strength could be sent to the absent warrior to help him in the stress of battle, or thought and will be projected to an absent friend to help him in a game or race. . . . A similar ability to aid or injure was attributed to the elements and to all natural forces." I am disposed to think that the special identity of *wakonda* with will-power

³ "Proceedings of the American Association for the Advancement of Science," 1897, p. 300.

is overstated here, if by will be meant conscious and purposive volition. Miss Fletcher's own examples, as well as Mr. McGee's, seem to me clearly to show that, in the Omaha's thinking, will-power falls as a special case under the general notion of *wakonda* as productive energy—"that which makes or brings to pass"—rather than *vice versa*. There is, in Miss Fletcher's exposition, just the *soupçon* of a tendency to read the categories of modern psychology and philosophy into the Omaha's vocabulary, and to make of the Indian somewhat too much of a Schopenhauerian pantheist, conceiving of *die Welt als Wille*. But so far as the main point is concerned, the passage cited gives us unimpeachable testimony to the existence among the Dakotan tribes of a distinct and rather abstract conception of a diffused, all-pervasive, invisible, manipulable and transferable life-energy or universal force. And Miss Fletcher's paper in its entirety makes it evident that, amongst these Indians, all success, strength or prosperity is conceived to depend upon the possession of *wakonda* in sufficient quantity.

In the case of the Dakotas we have also, as it happens, evidence which enables us to connect the name, and the idea, of *wakonda* (the import of which we have just seen) directly with one of the most important and widespread of primitive beliefs—the belief, namely, in the "supernatural" or magical powers inherent in the body of woman, especially at the catamenial periods. Everywhere amongst savage peoples, as we know, "the blood is the life"; and one of the most striking evidences of the presence of a special measure of vital energy the savage imagination finds in the mysterious sanguinary discharge characteristic of the child-bearing sex—which for primitive man undoubtedly meant originally the sex which alone had any essential part in the production of new human living beings. Now there are, as every student of savage custom knows, two

sides to the all but universal belief concerning the menstruant woman. On the one hand, she is dangerous to come near—especially for men—and radiates, as it were, an alarming sort of electricity; hence numerous taboos, and the almost world-wide custom of segregating women at such periods. But on the other hand, she is the source of a beneficent fecundating energy which can be transferred from her person to other things, especially to growing crops; hence the widespread “nudity charm,” in which she marches naked by night (usually at certain phases of the moon) over the newly-planted field, for the purpose of ensuring fertility to the seed buried there. Now concerning the Omahas we are informed that they spoke of the discharges by the name *wakondithican*, meaning “pertaining to *wakonda*” (Dorsey, *Omaha Sociology*, p. 267); a woman during this period was segregated, and if any should eat with her they would become sick and their blood would turn black. Her proximity was held to be especially dangerous to young children. On the other hand, as every reader of Longfellow’s *Hiawatha* knows, the use of the nudity-charm was customary among the Dakotas. It is described by Schoolcraft in his *Indian Tribes* (V, p. 70), where the connection of ideas between the *wakondithican* and the transferring of strength and fertility to the grain is sufficiently clear. Schoolcraft, it is true, represents the charm as primarily a protection against insects and blight, but it is probable that the idea was rather that of a direct projection of *wakonda* from the woman’s body to the seed;—possessing that energy. the seed could resist the attacks of all its natural enemies. We have an earlier account than Schoolcraft’s of a Dakotan fecundating ceremony in which the nudity-charm figures, where the conception of the transference of *wakonda* from woman to seed is unmistakably involved. A description of the corn-planting customs of the Osages is given

in a little French book published in 1827, *Histoire de la tribu des Osages*, by "M. V. P." The author of the book got his information from a party of Osages who were brought to Paris early in the last century. His report gives internal evidence of being honest and careful, and, so far as the external facts of custom are concerned, trustworthy; his translations of Dakotan terms, and his interpretations of his facts must, of course, be corrected by the later information that we have from Dorsey, McGee and Miss Fletcher. What "M. V. P." tells us is this: Women alone had charge of the corn-planting. When the time for planting came they went out naked at sun-rise [possibly this is an error, and should be "before sun-rise"] carrying a small quantity of seed-corn and invoked "*Houack-anda*" in these words: "The time has come for placing our corn in the ground; make fertile the corn that we here bring before thee!" For, as our author tells us, "les Osages croient en Dieu, qu'ils adorent sous le nom de Houackanda, que l'on peut traduire ainsi, 'Maître-de-la-vie.'" The ceremony was repeated on five consecutive mornings; then the grains thus fecundated were mixed with the rest of the seed-corn, and after allowing five more days for the power to spread through the whole of the grain, the women planted the corn in the confident expectation of an abundant harvest. This was very likely supplemented by the further nudity charm of marching by night over the planted field.

Now we know from Mr. Mc Gee and Miss Fletcher that *wakonda* does not mean a Supreme Being nor a personal spirit; and for M. V. P.'s translation *Maître-de-la-vie* we must substitute the impersonal "source of life-energy." But the translation of the French writer is just such as a European, imbued with theistic preconceptions, would be sure to give after hearing Indians try to explain what they meant by the term. M. V. P., again, represents

the words of the Indian women as a prayer; we must, making a similar correction, rather regard it as an incantation for putting *wakonda* into the seeds. And finally, he mentions the nudity of the women only incidentally; whereas, from all that we know about the nudity-charm, we may be quite sure that it was the essential feature of the whole ceremony. But when we make these corrections, and when we put these several items of information about the Dakotan tribes together, we get pretty clear evidence that *wakonda* was, amongst other things, conceived to be present in an especially great degree in the blood and in the person of the menstruant woman; that it had, when thus present in exceptional degree, both a dangerous and a beneficent aspect; and that in the latter aspect, it was a principle of fertility and vitality common alike to human and vegetal life, and transferable from the one to the other.

2. *Algonkins and Iroquois.* That a conception parallel to that of *wakonda* was expressed by the Algonkin word *manitou* and the Iroquois *oki* seems evident even from the superficial and unsympathetic observations of seventeenth century missionaries and explorers. Thus writes Roger Williams in his *Key to the Languages of America* (1643)⁴: "There is a general custom among them at the apprehension of any excellency in men, women, birds, beasts, fishes, etc, to cry out *Manitto*, that is, it is a god; as thus, if they see one man excel others in valor, strength, activity, etc., they cry out *Manitto*, a god. And therefore when they talk amongst themselves of the English ships and great buildings, and especially of books and letters, they will end thus: *Manittôwock*, they are gods; *Cummanitto*, you are a god." The Apostle to the Indians does not, to be sure, find in the linguistic usage that he thus describes quite the same significance that it has for

⁴ *Collections of the R. I. Hist. Soc.*, I.

the purposes of the present paper, but pleasantly and piously views it as evidence that "there is a strong conviction naturall in the soul of man that God is filling all things and places, and that all excellencies dwell in God and proceed from him, and that they only are blest who have Jehovah for their portion."

It is not the first nor the last time in history that very edifying reflections have been begotten of a bad translation. *Manitou*, upon Roger Williams' showing, evidently does not mean "a god," in the personal sense, but was applied to any manifestation of extraordinary power, or to any person or thing supposed to possess such power. Champlain still earlier (1616)⁵ bears witness to a similar usage among both Iroquois and Algonkins—though he draws from it a less edifying moral than does the benevolent Baptist. By a delightfully naive *jeu de mots* the explorer seriously seeks to make it appear that *oki* and *manitou* must mean "the Devil." It is better to give the passage in Champlain's own French:

"Ce qui fait plustost croire estre le Diable, qu'ils entendent, est que lors qu'ils voyent un homme faisant quelque chose extraordinaire, ou est plus habille que le commun, ou bien est vaillant guerrier, ou d'ailleurs en furie, comme hors de sa raison et de soy-mesme, ils l'appellent *Oqui*, comme si nous disions, un grand esprit sçavant, ou un grand Diable. Quoy que ce soit, ils ont de certaines personnes qui sont les *Oqui*, ou *Manitous*, ainsi appelez par les Algommequins, et ceste sorte de gens sont les Médecins pour guarir les Mallades, et pençer les Blessés." Compare with this a passage from Théodat's *Grand voyage au pays des Hurons*,⁶ which I translate as literally as is necessary:

"They have some respect towards those spirits that

⁵ *Œuvres*, IV, p. 86.

⁶ Paris, 1632, p. 230.

they call *Oki*; but this word *Oki* signifies a great *Devil*, just as well as a great *Angel*, a furious and demoniacal spirit (or mind, *esprit*) just as well as a spirit that is good, wise or inventive, that knows or does something beyond the ordinary. Thus they often called us by this name, because we knew and taught them things which went beyond their understandings, as they said. They also called their medicine-men and magicians *Oki*, and even those amongst them who were insane, mad, or possessed." For one more early piece of evidence concerning the use of the words *oki* and *manitou*, I add a passage from Bresani's *Breve Relazione* (1653)⁷: "They had a superstitious regard for everything which savored a little of the uncommon. For example, if in their hunt they had a difficulty in killing a stag or a bear, and on opening it they found in its head or in its entrails a bone or a stone or a serpent, they said that such an object was an *oki*—that is, an enchantment which gave force and vigor (*forza e vigore*) to the animal so that it could not be killed; and they used it as the superstitious use reliquaries,⁸ in order to be always prosperous."

These passages from early observers of Indian customs and linguistic usages show us, it is true, only the application of the words *oki* and *manitou* in the concrete to persons or things characterized by unusual powers; they do not show us the use of the words as names for a single, pervasive property or force of which those persons and things are supposed to be the possessors. But after these citations had been transcribed for the present paper, there has appeared an important exposition of the Algonkin idea of *manitou*⁹ by Mr. W. Jones, based upon a special study of the Sac and Fox and Kickapoo tribes. Mr. Jones' account

⁷ In *Jesuit Relations*, XLIX, p. 25.

⁸ Here is the origin of the amulet and of some sorts of fetishes.

⁹ "The Algonkin Manitou," in *Amer. Jour. of Folk-Lore*, 1905, pp. 183-191.

of the meaning of *manitou* shows that it expresses precisely the same ideas as those which, upon the evidence of specialists upon the Dakotan tribes, we have seen to be expressed by *wakonda*; and since our seventeenth century testimonies show us a complete parallelism in the employment of *manitou* and the Iroquois *oki*, it is evident that the principal term in the religious vocabulary of each of these three great North American stocks corresponds to the single conception of a diffused but unequally distributed cosmic energy. *Manitou*, Mr. Jones tells us, is primarily an impersonal substantive: "in the Algonkin dialect of the Sac, Fox and Kickapoo, a rigid distinction of gender is made between things with life and things without life; . . . when they refer to *manitou* in the sense of a virtue, a property, an abstraction, they employ the form expressive of inanimate gender," though "when the property becomes identified with objects in nature, the gender becomes obscure and confused." The Algonkin "feels that the property is everywhere, is omnipresent. The belief that it is omnipresent naturally leads to the belief that it enters into everything in nature, and the notion that it is active leads the mind to look everywhere for its manifestations." "To experience a thrill is evidence enough of the existence of the substance." "There is a lively sense of its miraculous efficiency." When the Algonkin eats the heart of an especially brave enemy, slain in battle, it is for the purpose of absorbing *manitou* into himself. Particularly instructive is the explanation of the meaning of the sweat-lodge observances, given Mr. Jones by an Indian of the Fox tribe: "Often one will cut oneself over the arms and legs, . . . it is done to open up many passages for the *manitou* to pass into the body. The *manitou* comes from its place of abode in the stone. It becomes aroused by the heat of the fire, . . . proceeds out of the stone when the water is sprinkled upon it, . . . and in the steam it enters the body, . . . and imparts

some of its nature to the body. That is why one feels so well after having been in the sweat-lodge."

The great majority of the religious or magical ceremonies and observances customary amongst these Indian peoples are clearly more or less directly connected, in their minds, with the idea of *manitou*, *oki*, or *wakonda*. Totemism (as Miss Fletcher has shown), the fetish or "personal medicine," the ceremonies connected with agriculture, the taboos relating to women, the sweat-lodge ceremonies, the beliefs relating to blood and the heart: all these can be shown, not by the inferences of folk-lorists but from the language of the Indians themselves, to get their meaning from the one underlying conception concerning the nature, distribution, and special vehicles, of that impersonal vital energy by the possession of which all power and efficacy is acquired. And the list apparently does not end here. "The rules of the buffalo hunt," says Dorsey,¹⁰ "the consecration of the hearts and tongues, the ceremonies pertaining to the anointing of the sacred pole, and those connected with planting of the corn, were customs which were regarded as laws received by their ancestors from Wakanda." Dorsey here gives what we know to be an erroneous personification to *wakonda*; but what his Indian informants were trying to tell him, we may reasonably suppose, was that all these ancestral customs had always been regarded as having something to do with the *wakonda* idea.

II. MELANESIANS AND POLYNESIANS.

That the same conception is current amongst the more or less mixed races of Oceania we know from the best authorities upon the ethnology of the island peoples. "The Melanesian mind," says Codrington,¹¹ "is entirely pos-

¹⁰ *Omaha Sociology*, p. 368.

¹¹ *The Melanesians*, 1891, p. 118.

sessed by the belief in a supernatural power or influence, called almost universally *mana*. This is what works to effect everything which is beyond the ordinary power of men, outside the common processes of nature, attaches itself to persons and to things, and is manifested by results which can only be ascribed to its operation." And again:¹² "It is a power or influence not physical and in a way supernatural; but it shows itself in physical force or in any kind of power or excellence which a man possesses. This *mana* is not fixed in anything, and can be conveyed in almost everything; but spirits, whether disembodied souls or supernatural beings, have it and can impart it; and it essentially belongs to personal beings to originate it, though it may act through the medium of water or a stone or a bone. *All Melanesian religions consist in obtaining 'mana' or deriving benefit from it.*" The Polynesian *atua*, says Ratzel, has a similar meaning; and the idea "recurs in *Ani* or *Han* of Ponape, the *Kasinge* or *Kalit* of Pelew, the *Anut* of Kusaie, and the *Yaris* of Tobi," Among the Maori, we are told,¹³ "the generic name of *atua* which applied to every kind of supernatural beings and mysterious objects did not convey a distinct idea of god or a divinity, but it was simply an invisible, shadow-like existence, an impalpable breath, whose nature was mysterious, without definite attributes or well-defined powers of action. . . . Their *atua* was a mysterious something which they could not explain, a name given to all active agencies of nature whose mode of action was incomprehensible, but which were nevertheless supposed to produce real and palpable results in the social and physical economy of the world. The strangers that first came among them sending thunder and lightning by the discharge of the fire-arms were real *atuas*. A watch, whose

¹² P. 119, note.

¹³ Featherman, *Social History of the Races of Mankind*, II, p. 207.

wonderful movements they did not understand, was an *atua*," etc.

In the case of the Malagasy, a race akin to the Polynesians, the same conception is expressed by the word *andriamanitra*. "Whatever is great, whatever exceeds the capacity of their understandings, they designate by the convenient and comprehensive designation *andriamanitra*. Whatever is new and useful and extraordinary is called god."¹⁴

III. THE BANTU.

Much as has been written about the Bantu peoples, there has, I believe, until very lately been no good evidence of the prevalence amongst them of a similar idea—so readily does the nature of such an idea escape the apprehension of ethnographers and missionaries. Quite recently, however, Mr. A. Hetherwick, for many years a missionary at Blantyre, has informed us—apparently without knowing of the existence of a similar usage amongst other races—that the commonest and most familiar term in the religious vocabulary of some (at least) of the Bantu tribes is used in a sense precisely analogous to that which we have seen to belong to *wakonda*, *oki*, *manitou*, and *mana*.¹⁵ "The word *mulungu*," he writes, "is used by the Yao in a wide application. Etymologically the word is connected with the root *kulungwa*, which in so many other branches of the Bantu tongue appears as *kulu* or *kuru* and signifies 'great' or 'old.' It is the same word which appears in the Kaffir word for God, *Unkulunkulu*, which may be rendered as 'the old, old one' or 'the great, great one.' In its native use and form the word does not imply personality, for it does not belong to the personal class of nouns. Its form rather denotes a property inhering in

¹⁴ Ellis, *Hist. of Madagascar*, cited by Marett in *Folk-Lore*, 1900, p. 169.

¹⁵ In *Journal of the Anthropol. Inst. of Great Britain*, Vol. 33, p. 93.

something, as life or health inheres in the body. Among the various tribes where the word is used, missionaries have adopted it as the word for God. But the untaught Yao refuses to assign to it any idea of being or personality. It is to him more a quality or a faculty of human nature, whose significance he has extended so as to embrace the whole spirit world. [Yet] the Yao speaks of what *mulungu* has done or is doing. It is *mulungu* who [sic] made the world, man and animals. . . . *Mulungu* is regarded also as the agent in anything mysterious. 'It is *Mulungu*!' is the Yao's exclamation on being shown anything that passes the range of his understanding."

There is reason to suppose that among the mixed Hamitic-Negro stock, the Masai, a similar meaning and the same peculiar width of application belongs to the term *ngai* or *en-gai*. "Their conception of deity," says Thomson, in his *Through Masailand*,¹⁶ "seems marvelously vague. I was *ngai*. My lamp was *ngai*." In fact, whatever struck them as strange and incomprehensible, that they at once assumed has some connection with *ngai*." A more recent writer upon the Masai,¹⁷ it is true, declares that "the prayers for children, rain and victory are addressed to *En-gai* as a distinct personality 'who is prayed to and hears.' " But the same writer adds that, "on the other hand, the sun and moon, the morning and evening star and the mountain clouds are also invoked" (apparently under the same name), and that "in one song a certain medicine-man appears to be expressly referred to as *En-gai*." Mr. Hollis suggests, therefore, that we may "have here primitive and undeveloped religious sentiment where the personality of the deity is hardly separated from striking natural phenomena."

¹⁶ 1885, p. 445.

¹⁷ Hollis, *The Masai*, 1905, p. xix.

I have cited these testimonies with perhaps excessive fullness and in the words of the original describers of the usages in question, for the reason that the (in some cases) almost verbal identity of the accounts given by so many independent observers of three wholly distinct races, seems to me in itself a significant circumstance. By several of these observers the finer ramifications and the less obvious meanings of the idea were missed; but nearly all—whether they are describing North American, Melanesian, Polynesian or African—insist upon certain identical points, namely: that the most important and most frequently employed religio-magical term in the languages of these peoples is the name of something rather impersonal than personal; that the conception of this something wavers between that of a communicable property, that of a mobile, invisible substance and that of a latent transferable energy; that this substance, property or energy is conceived as being widely diffused amongst natural objects and human beings; that the presence of it is promptly assigned as the explanation of any unusual or exceptional power or efficacy which any object or person is found to possess; that the mind of the savage of these races is intensely interested in this force or property and greatly preoccupied with the thought of it. And in the case of the American Indians the evidence shows us still more. With them the conception is distinctly that of a pervasive energy, which tends to become especially localized in particular objects; and their languages as well as their customs show that this idea is directly involved in their beliefs concerning the special dangers and also the special magical efficacy connected with blood and with the sexual peculiarity in women. Furthermore, we have seen that, among the Indians, the same productive power that is, naturally enough, conceived to manifest itself in the vital fluid and the body of the child-bearing sex, is likewise conceived to be the source

of all fertility in nature; and that the purpose of their agricultural fertility-charms and sacrifices is expressly that of transferring this indispensable energy from beings or objects that possess it in superabundance to the growing crop. And since the Indian way—the peculiar and striking way—of using the word *manitou* or *wakonda*, as reported by more superficial observers, is precisely the same as the usage of *mana*, *atua*, *ngai*, and the rest, as reported by other superficial observers, it seems, to say the least, not improbable that the meaning and the associations of ideas which a more accurate observation shows to belong to *manitou* and *wakonda* also belong to the corresponding Melanesian, Polynesian, and Bantu words.

When, therefore, I attempt—as I shall subsequently do—to connect in detail a great variety of savage customs and beliefs with this conception, I shall at least be dealing with a *vera causa*—with an idea that is not merely inferred from the customs which it is used to explain, but can be shown to exist by independent evidence. The facts of linguistic usage here adduced already indicate the prime importance of this conception in the savage philosophy, and give us the clue to its ramifications and specialized applications in the scheme of primitive belief. On the other hand, it is not until those customs are examined and correlated, that one can understand adequately the scope and the influence of the conception, and the way in which the mind of undeveloped man works in the use of it. In a word, evidence from language and evidence from the analysis and comparison of customs and ceremonies will be found reciprocally to corroborate and illuminate one another; and taken together, I think, they suffice to make it clear that the idea of *manitou* or *mana* lies at the bottom—though in different manners and for different reasons—of many sorts of taboos; of the beliefs and observances relating to woman and her supernatural powers; of several

kinds of sacrifice; of a number of periodic ceremonies and feasts connected with agriculture among most agricultural races, and, indeed, of the greater part of all primitive agricultural rites; of moon and sun cults, or at least of certain features commonly characteristic of those cults; of the observances relating to the "sacred fire"; of some frequent features of the initiation rite; and of certain elements of the primitive eschatology. There is no "key to all the mythologies"; that is to say, the several aspects of the thought of savage man—its animism, its ghost-beliefs, etc.,—are not reducible to one another, nor necessarily traceable to a common origin. But there is one idea which is of paramount importance in the early evolution of religious and scientific thought and practice, for the reason that it generates a large part of primitive belief and custom, and widely and subtly interpenetrates the beliefs and customs which have an independent origin.

The place of this conception in the thought of savage races has, for the most part, gone unrecognized by folklorists and writers on primitive religion. It is hardly too much to say that most of the systematic treatises on these subjects essentially misrepresent primitive belief, and explain wrongly most of the customs of which they treat, through their neglect of the *manitou*-idea. Even so recent and so admirably learned a work as Mr. Frazer's *The Golden Bough* takes no sufficient account of that idea, while it very much overworks the notion of sympathetic magic. To Mr. Frazer the term *wakonda* is simply synonymous with *tabu*; of its real meaning, and of its real synonyms in the other Indian languages and those of the Polynesians, Melanesians and Bantu, he apparently knows nothing.* Similarly Mr. Ernest Crawley's recent study of primitive marriage, *The Mystic Rose*, 1902, which deals chiefly with sexual taboos, misses (I cannot but think) the true expla-

* *Golden Bough*, 2d. ed., I, p. 343.

nation of most of those taboos altogether, through a failure to connect them with the same idea. But it ought to be observed that several writers have already noticed this feature of savage thought, and that the disposition to recognize its nature and importance is steadily growing. Dr. Brinton, for example, knew the Indian languages and customs far too well to miss this point altogether. "*Wakonda*," he wrote in his last work,¹⁸ "was not a deity, but expressed the deific power believed to be present in men, animals and things." And more generally, he notices the occurrence in early thought of the idea that "all gods and holy objects were merely vehicles through which life and power poured into the world from the inexhaustible and impersonal source of both."¹⁹ Yet in the same volume we find the inconsistent declaration already noted, that the "psychic origin of all religious thought" is the "belief that behind the phenomenal world lies the ultimate power of mind, of conscious will, of intelligence analogous in some way to our own." "To the undeveloped reason the Other is ever conceived as Another, a Self, and is clothed with the attributes of the thinking Ego." Dr. Brinton thus failed to make serious use of the truth of which he had caught a glimpse—which is the more unfortunate because his book is in many respects well fitted to be what it has actually become, the best-known popular manual of the subject.

A little later Mr. R. R. Marett called attention to the peculiar use of the terms *mana*, *wakonda*, *ngai*, *andriamanitra*, and made that usage the basis of his theory of a "pre-animistic religion."²⁰ Mr. Marett does not, however, seem to me to do full justice to all sides of the belief which was "logically and chronologically prior to Anim-

¹⁸ *Religions of Primitive Peoples*, 1897, p. 60.

¹⁹ *Ibid.*, p. 164.

²⁰ In *Folk-Lore*, 1900, p. 180.

ism, constituting as the latter does but a particular embodiment of the former." For he finds the essence of that belief to lie in the apprehension "of the supernatural or supernormal, as distinguished from the natural and normal." It arose when "the emotions of awe, wonder, and the like. . . outstripped the power of 'natural,' that is, of reasonable explanation." "Of all English words Awe is, I think, the one that expresses the fundamental religious feeling most nearly. . . *Primus in orbe timor fecit deos* is true only if we admit wonder, admiration, interest, respect, even love perhaps, to be, no less than fear, essential constituents of these elemental moods." Mr. Marett accordingly proposes to name this primordial religious attitude "Supernaturalism," or preferably, "Teratism." Now such a theory is naturally enough suggested by the peculiarity of the use of the terms in question which most commonly strikes the missionary and the traveler; namely, the savage's fashion of promptly applying those terms to anything novel, surprising, incomprehensible or alarming. But I think a careful consideration of the passages cited earlier in this paper will make it evident that *wakonda* or *manitou* or *mana* are not primarily names for the "supernormal" or the astonishing—and certainly not for the which evokes awe, respect and love—but rather for the efficacious, the powerful, the productive. What the "elemental mood" was we really do not know; what we do know is that the *wakonda* or *mana* that the actual savage is so supremely concerned about is essentially a sort of diffused substance or energy upon the possession of which all exceptional power or ability or fecundity depends. This energy is, to be sure, terrible (under certain circumstances) and it is mysterious and incomprehensible; but it is so because it is vastly powerful, not because the things that manifest it are unusual or "supernatural" or such as "defeat reasonable expectation." In other words, Mr. Ma-

rett appears to me to put the emphasis on the wrong side, and consequently to underestimate the importance of this idea in engendering all sorts of magical observances of a fecundative or prophylactic sort. The pre-animistic belief—the belief which is, at all events, independent of animism—is not best described as “supernaturalism” or “teratism,” for the fundamental notion in it is not that of the unpredictable, abnormal and portentous, but that of a force which is conceived as working according to quite regular and intelligible laws—a force which can be studied and controlled. A better name, then, for this group of beliefs would be “Primitive Energetics.” In spite of these criticisms, however, Mr. Marett’s paper is notable as being probably the earliest to insist clearly and unequivocally upon the primacy in early thought of a non-animistic conception expressed by such terms as *wakonda* and its synonyms.

Still more recently MM. Hubert and Mauss, writing in *L'année sociologique* for 1902-3, seem to have substantially anticipated the main conclusions of the present paper. Their *Mémoire*²¹ I have been unable to see; but upon essentials it apparently agrees pretty closely with the theory here presented. Finally Prof. D. N. Söderblom, in his little manual *Die Religionen der Erde*²² has set forth briefly and inadequately, but quite clearly, some aspects of what he calls the conception of *Lebenselektrizität* in savage belief.

In concluding, it is worth while to urge upon ethnologists and students of early religion the adoption of a rec-

²¹ It is known to me only from Mr. Hartland’s notice in *Folk-Lore*, 1903; and has come to my attention after the greater part of this paper was completed. It is perhaps proper to mention that the conclusions here set forth were reached in 1900, independently of any of the writers mentioned, though they were much influenced by the writer’s studies under the late Léon Marillier—whose unrivalled stores of accurate learning concerning savage thought and custom were lost to science through his untimely death, before he had published any work commensurate with his knowledge and his powers.

²² 1905, p. 8-9.

ognized and unambiguous name for the sort of primitive conception that has here been set forth and that promises soon to receive the general attention that it deserves. I have already intimated that, if one must have a word of Greek or Latin origin, "Primitive Energetics" appears to be a better name than either of those suggested by Mr. Marett. But the use, in naming features of savage belief, of stems already found in other English words, and having already established connotations, has proven to be a disadvantageous practice. Terms so constructed are almost certain to be both equivocal and misleading. Tylor's invention of the term "animism," for example, has introduced a singular amount of confusion into ethnology. A good deal of Mr. Spencer's labored and unprofitable reasoning concerning the origin of religion is, for example, almost wholly due to the more or less misleading connection between the words "animism" and "animate." It is better, where possible, to adopt as the designation of a widespread primitive concept or custom one of the native names for it. Of the concept here under discussion the North American Indian names are perhaps the most familiar, and their full scope and meaning has been most clearly and authoritatively set forth. *Wakonda* and *oki*, however, are vocables that cannot very expressively or euphoniously be anglicized. The Algokin *manitou* is less open to this objection and it is, in any case, the most generally familiar of all the Indian terms of this class. I venture, therefore, to propose that those who treat of such matters should agree—until a better name be found—to refer to the primitive belief in a pervasive, life-giving, impersonal energy as *manitouism*, and to that energy itself as *manitou*.

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THE BIBLE, THE PERSIAN INSCRIPTIONS, AND THE AVESTA.

HOW our distinguished popular expounders of the Bible can proceed in their all-important tasks without some attempt to acquire such interior information as may be available about the religion of Cyrus and Darius is difficult for an expert to understand.

These imperial persons, according to our own venerated Semitic Scriptures, actually restored the Jewish tribes to Jerusalem, permitting, encouraging and assisting the rebuilding of the city and even of the Temple.

As we read throughout Ezra and the rest, it is obvious that they did everything which it was conceivable for them to do to meet the national religious aspirations of the exiled tribes; and that they did so, moved by some correspondence between their own religious opinions and those of their protégés was at least believed by the Jewish writers to be the fact; see the extensive statements everywhere.

And we may indeed certainly concede that the Persian rulers were animated by some measure of sentiment aside from political expediency. According to the Jews Cyrus was actually inspired by "the God of Heaven" to take the course which he did take toward the Israelites—and in Isaiah xliv and xlv he is accepted by Yahveh Elohim as 'His Anointed'; and we may safely infer that the same approbation was supposed by Ezra and his colleagues to have been present in the mind of the Jewish Deity toward Darius

and his successors. If we had no records whatever of these distinguished Iranian monarchs, our inattention might be condoned, for we could then only dimly conjecture what their religion might have been; but we possess documents of it which surpass in certified authority almost all other equally ancient records of the human race. For their main bulk consists of the well-preserved Persian Inscriptions of Behistan, Persepolis, Naksh i Rستم, etc. These impressive sculptures have long since been deciphered, and except for an isolated difficulty here and there they are easier than the Bible, that is to say, than parts of it; they are certainly easier than the Avesta. They are of course meagre as to extent when regarded as literature; but they are perhaps the fullest of all closely related inscriptions upon stone, while their religious fervor, whether genuine or affected, is the strongest ever recorded in such writings and hardly surpassed by any compositions anywhere. Nowhere in literature within the same compass of words are such trenchant and dogmatic assertions made of the existence of One Supreme God as the Creator of "this Earth and yon Heaven, of man, and of amenity for him"—and not even in the Psalms have we more strenuous iterations of personal faith. "Then I prayed to Auramazda," Darius wrote for his stone-cutters, "Auramazda brought me aid—by the gracious will of Auramazda I became King;" and from that on everything favorable which he did or which happened to him occurred, as he asserts, "through the gracious will of Auramazda." The name, as we know, was one of the purest and most significant perhaps ever applied to a believed-in deity, probably far superior to our own word "God" in both its origin and bearing.* It means "the life-spirit-Lord, the Great Creator"; or the latter word may mean "the Wise One"; so my

* In the light of refined reason, and in view of all Indian usage, compare Asura which is Ahura;—what name approached it?

colleagues generally prefer, following tradition. He restored the temples which Bardiya (Smerdes) destroyed in his Magian iconoclasm just as he and Cyrus restored the temple at Jerusalem, and as Cyrus restored the Temple City Eshshakil (so) at Babylon, and there is hardly a place where the words "by the gracious will of Auramazda" could come in where they are not cut. The iteration is unexampled. He must have been the champion hypocrite of all the ages if he did not believe that God was indeed his supporter.

But these quite astonishing accumulations of fervent personal religious feeling have a certain peculiarity which at once deepens as it intensifies our problem.

It is this: the same expressions recur without variation, letter for letter, throughout the reigns of Darius, Xerxes, Artaxerxes the II and the III, something over a hundred years. We have indeed the side sentence showing deeply-rooted and superficially animated sentiment,—but even these are repeated like formulas while the main phrases were positively such; they must have headed many a political document as well as these formal summaries of sculptured history.

The chief terms were of course household words as well as familiar in every possible school of religious learning, or center of public service, which is of course a matter of deepest import to the history of religion;—for it proves something so hard to believe that we are almost tempted to exclamatory adjectives. It seems actually to establish the certain fact that in a most effective percentage these formulas expressed the sincere religious convictions of a portion of the populations, and if only of a portion, yet how vast must have been the aggregate.

If Darius ruled from Egypt to India and from the Ocean to the Caspian, surely five per cent. alone must have meant a million souls, and that in generation after gen-

eration. Is it possible that these people could have been intellectually convinced, as no such populations upon the face of the earth were then convinced, of the omnipotence of a supreme good God, whose primal attribute was truth, and yet not have experienced some genuine religious emotions which ultimately formed themselves into religious principles and religious character, especially among that portion of the people who were still young? Surely every pastoral clergyman knows that this is impossible. People by the millions must have been genuinely pious in Persia under the Achæmenids.

We are still, let us hope, acutely sensible of the importance of religious revivals, although they may have taken place in times long past and resulted from the early propagation of the Gospel,—and these latter claim of course a sacred precedence among all revolutions of religious sentiment,—but no true Christian can ignore the possible regenerations of moral character which must have taken place under this sublime and simple creed of Darius and of the Gathas. Of course other gods are recognized such as Mithra and Anahita, and so in the later Avesta. We Christians have also our Archangels, and it can hardly be said that we refrain from worshiping our saints; that is to say, not those of us who have the pre-eminent right to represent the Faith. In the wonderful Gathas, however, which are closely related to the inscriptions, there is no Mithra mentioned, nor is there any Anahita, and the Archangels themselves are primarily the attributes of God. It was by far the most intellectual and refined system that had ever been developed anywhere at their period or, as some might say, since then.

We must not indeed conceal the defect that even Darius in the very acme of his almost passionate expressions (of trust in God) takes pains to record and with obvious satisfaction his execution of his captured arch-enemies, and he

does not shrink from giving us the details of his barbarity; but we must also not forget that if Darius had not struck terror upon his other opponents by such ghastly exhibitions, those other opponents would undoubtedly have experienced no hesitation;—they would have struck terror upon his survivors by executing him with every exactly similar fiendish horror;—moreover these infamies have been at least equalled, if not indeed excelled in the executions of Christian believers by Christian believers themselves.

And we can not say that the masses of the populations were responsible for these enormities (though they evidently thought them to have been deserved), so that we cannot at all on this account exclude the conviction that a really vast amount of genuine personal piety, equal in its type to that of our own middle ages, must have prevailed in the Persian Empire at this period.* Can Christian pastors and teachers afford to ignore this mighty spiritual fact, or great series of facts in teaching the Bible to their hearers, especially when it is indubitably true that the whole course of our religious history might have been, nay must have been, different but for the interposition of those friendly rulers? Christ doubtless would have been born in the fulness of time, and would have taught and agonized, but who can say that these events would have taken place in Palestine, and have possessed at all the influence which they have now in fact exerted? Surely we can spare a few cheap hours for finding out what lies beneath it all.

LAWRENCE H. MILLS.

OXFORD, February, 1906

* See my detailed remarks in *Zarathushtra, the Achaemenids and Israel*.

MAGIC CUBES.

THE curious and interesting characteristics of magic squares may be applied to figures of three dimensions constituting magic cubes.

Cubes of odd numbers may be constructed by direct and continuous process, and cubes of even numbers may be built up by the aid of geometrical diagrams. In each case the constructive methods resemble those which were explained in a previous article in connection with odd and even magic squares.

CHARACTERISTICS OF MAGIC CUBES.

The characteristics of magic cubes, odd or even, are that all straight columns, whether running from the top of the cube to the bottom, from the front to the back, or from one side to the other, should sum up to the same amount, also that the four diagonal columns which unite the eight corners of the cube and the two corner diagonal columns of every square in the cube should sum up to the same amount as the straight columns. Furthermore, the sum of any two numbers that are located in cells diametrically opposite to each other and equidistant from the center of the cube should equal the sum of the first and last numbers of the series used, and in all odd magic cubes, the center cell must contain the middle number of the series. Magic cubes which do not exhibit these characteristics may be considered imperfect.

Using N to express the number of cells in one column of a cube, which begins with unity and proceeds with increments of 1, the sum of the numbers in each column is expressed by the formula:

$$\frac{N}{2} (1 + N^2)$$

If the initial and increment numbers are more or less than unity, the following general formula may be used to express the column value.

Let:

A = initial number,

B = increment number,

N = number of cells in each column,

S = summation number,

then:

$$\frac{N}{2} [B(N^2 - 1) + 2A] = S.$$

ODD MAGIC CUBES.

The smallest magic cube is naturally $3 \times 3 \times 3$. The twenty-seven numbers in this cube are capable of many different magic arrangements, none of which, however, possess perfect characteristics.

10	24	8
23	7	12
9	11	22

FIG. 1.

Fig. 1 shows one of these cubes, and in columns I, II and III, Fig. 2, there are given the nine different squares which it contains. In this cube there are twenty-seven straight columns, two diagonal columns in each of the

three middle squares, and four diagonal columns connecting the eight corners of the cube, making in all thirty-seven columns each of which sums up to 42. The center number is also 14 or $\frac{1 + N^3}{2}$ and the sum of any pair of geometrically opposite numbers is 28 or $1 + N^3$. In these points this cube approaches perfection, but it fails in the fact that the totals of the corner diagonals of the six outside squares consist of various numbers other than 42.

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FIG. 2.

All totals = 42.

In describing the direct method of building odd magic squares in a previous article, many forms of regular advance moves were explained, including right and left diagonal sequence, and various so-called "knights' moves." It was also shown that the order of regular advance was periodically broken by other well defined spacings which were termed "breakmoves." In building odd magic squares, only one form of breakmove was employed in each

square, but in the construction of odd magic cubes, two kinds are required in each cube which for distinction may be termed N and N^2 breakmoves respectively. In magic cubes which commence with unity and proceed with increments of 1, the N^2 breakmoves occur between each multiple of N^2 and the next following number, which in a $3 \times 3 \times 3$ cube brings them between 9 and 10, 18 and 19, and also between the first and last numbers of the series, 27 and 1. The N breakmoves are made between all other multiples of N , which in the above case brings them between 3 and 4, 6 and 7, 12 and 13, 15 and 16, 21 and 22, and 24 and 25. With this explanation the rules for building the magic cube shown in Fig. 1 may now be formulated, and for convenience of observation and construction, the cube is divided horizontally into three sections or layers, each section being shown separately in Column I, Fig. 2.

It may be mentioned that when a move is to be continued *upward* from the top square it is carried around to the bottom square, and when a move is to be made *downward* from the bottom square, it is carried around to the top square, the conception being similar to that of the horizontal cylinder used in connection with odd magic squares.

Commencing with 1 in the center cell of the top square, the cells in the three squares are filled with consecutive numbers up to 27 in accordance with the following directions:

Advance move. One cell down in next square up (from last entry).

N breakmove. One cell in downward right hand diagonal in next square down (from last entry).

N^2 breakmove. Same cell in next square down (from last entry).

If it is desired to build this cube from the three vertical squares from front to back of Fig. 1, as shown in Column II, Fig. 2, the directions will then be as follows: commencing with 1 in the middle cell of the upper row of numbers in the middle square,

Advance move. One cell up in next square up.

N breakmove. One cell in downward right-hand diagonal in next square up.

N² breakmove. Same cell in next square down (from last entry).

TABLE I

	A	B	C		A	B	C		A	B	C
1	/	/	/	10	2	/	/	19	3	/	/
2	/	/	2	11	2	/	2	20	3	/	2
3	/	/	3	12	2	/	3	21	3	/	3
4	/	2	/	13	2	2	/	22	3	2	/
5	/	2	2	14	2	2	2	23	3	2	2
6	/	2	3	15	2	2	3	24	3	2	3
7	/	3	/	16	2	3	/	25	3	3	/
8	/	3	2	17	2	3	2	26	3	3	2
9	/	3	3	18	2	3	3	27	3	3	3

FIG. 3.

Finally, the same cube may be constructed from the three vertical squares running from left to right side of Fig. 1, as shown in Column III, Fig. 2 commencing, as in the last example, with 1 in the middle cell of the upper row of numbers in the middle square, and proceeding as follows:

Advance move. Three consecutive cells in upward right-hand diagonal in same square (as last entry).

- breakmove. One cell in downward right-hand diagonal in next square down.
- ² breakmove. One cell down in same square (as last entry).

Five variations may be derived from this cube in the same way illustrated in Table I on the preceding page.

Assign three-figure values to the numbers 1 to 27 inclusive in terms of 1, 2, 3 as given in Table I, Fig. 3, and change the numbers in the three squares in Column I, Fig. 3, to their corresponding three-figure values, thus producing the square shown in Fig. 4. It is evident that if the arrangement of numbers in the three squares in Column I were unknown, they could be readily produced from Fig. 3 by the translation of the three-figure values into regular numbers in accordance with Table I, but more than this can be accomplished. The letters A, B, C in Table I in-

	A	B	C	A	B	C	A	B	C	
Top Square	2	1	1	3	3	2	1	2	3	1 st Line
	3	2	3	1	1	1	2	3	2	2 nd .
	1	3	2	2	2	3	3	1	1	3 rd .
Middle Square	3	2	2	1	1	3	2	3	1	1 st Line
	1	3	1	2	2	2	3	1	3	2 nd .
	2	1	3	3	3	1	1	2	2	3 rd .
Bottom Square	1	3	3	2	2	1	3	1	2	1 st Line
	2	1	2	3	3	3	1	2	1	2 nd .
	3	2	1	1	1	2	2	3	3	3 rd .

FIG. 4.

indicate the normal order of the numerals 1, 2, 3, but by changing this order other triplets of 3×3 squares can be made which will differ more or less from the original models in the arrangement of their cell numbers, but which will retain their general magic characteristics. The

changes which may be rung on A, B, C, are naturally six, as follows:

A. B. C.	C. B. A.
B. C. A.	B. A. C.
C. A. B.	A. C. B.

2 18 22 24 1 17 16 23 3	4 18 20 26 1 15 12 23 7	2 24 16 18 1 23 22 17 3	4 26 12 18 1 23 20 15 7	10 24 8 26 1 15 6 17 19
15 19 8 7 14 21 20 9 13	17 19 6 3 14 25 22 9 11	15 7 20 19 14 9 8 21 13	17 3 22 19 14 9 6 25 11	23 7 12 3 14 25 16 21 5
25 5 12 11 27 4 6 10 26	21 5 16 13 27 2 8 10 24	25 11 6 5 27 10 12 4 26	21 13 8 5 27 10 16 2 24	9 11 22 13 27 2 20 4 18

FIG. 5. (B. C. A.) FIG. 6. (C. A. B.) FIG. 7. (C. B. A.) FIG. 8. (B. A. C.) FIG. 9. (A. C. B.)

The combination of 1, 2, 3 being given in normal order in the original cube, the five cubes formed from the other combinations are shown in Figs. 5, 6, 7, 8, and 9.

These magic cubes may also be constructed by the direct method in accordance with the simple directions set forth in the adjoined diagram.

Fig 10 is an example of another $3 \times 3 \times 3$ cube in

TOP SQUARE.	MIDDLE SQUARE.	BOTTOM SQUARE.
1 17 24 15 19 8 26 6 10	23 3 16 7 14 21 12 25 5	18 22 2 20 9 13 4 11 27

FIG. 10.

which the first number occupies a corner cell, and the last number fills the diametrically opposite corner cell, the middle number coming in the center cell in accordance

DIRECTIONS FOR CONSTRUCTING THE $3 \times 3 \times 3$ MAGIC CUBE SHOWN IN FIG. I, AND FIVE VARIATIONS OF THE SAME.

COMBINATION	ADVANCE MOVES	N BREAKMOVES	N ² BREAKMOVES
A. B. C.	One cell down in next square up	One cell in right-hand downward diagonal in next square down	Same cell in next square down
B. C. A.	Three consecutive cells in upward left-hand diagonal in same square	One cell to left in next square up	Same as in A. B. C.
C. A. B.	One cell to right in next square up	One cell up in next square up	Same as in A. B. C.
C. B. A.	Same as in B. C. A.	Same as in C. A. B.	Same as in A. B. C.
B. A. C.	Same as in A. B. C.	Same as in B. C. A.	Same as in A. B. C.
A. C. B.	Same as in C. A. B.	Same as in A. B. C.	Same as in A. B. C.

with the rule. Fig. 11 shows this cube with the numbers changed to their three-figure values from which five variations of Fig. 10 may be derived, or they may be constructed

	A	B	C	A	B	C	A	B	C	
<i>Top Square</i>	1	1	1	2	3	2	3	2	3	1 st Line
	2	2	3	3	1	1	1	3	2	2 nd .
	3	3	2	1	2	3	2	1	1	3 rd .
<i>Middle Square</i>	3	2	2	1	1	3	2	3	1	1 st Line
	1	3	1	2	2	2	3	1	3	2 nd .
	2	1	3	3	3	1	1	2	2	3 rd .
<i>Bottom Square</i>	2	3	3	3	2	1	1	1	2	1 st Line
	3	1	2	1	3	3	2	2	1	2 nd .
	1	2	1	2	1	2	3	3	3	3 rd .

FIG. 11.

directly by the directions which are marked in the diagram with the changes of A. B. C. for convenient reference.

The analysis of the numbers in Fig. 1 and Fig. 10 into their three-figure values in terms of 1, 2, 3, as shown in Figs. 4 and 11, makes clear the curious mathematical order of their arrangement which is not apparent on the face of the regular numbers as they appear in the various cells of the cubes. For example, it may be seen that in every subsquare in Figs. 4 and 11 (corresponding to horizontal columns in the cubes) the numbers 1, 2, 3 are each repeated three times. Also in every horizontal and perpendicular column there is the same triple repetition. Furthermore, all the diagonal columns in the cubes which sum up to 42, if followed into their analyses in Figs. 4 and 11 will also be found to carry similar repetitions. A brief study of these figures will also disclose other curious mathematical qualities pertaining to their intrinsic symmetrical arrangement.

The next odd magic cube in order is $5 \times 5 \times 5$, and Fig. 12 shows one of its many possible variations. For convenience, it is divided into five horizontal sections or

DIRECTIONS FOR CONSTRUCTING THE $3 \times 3 \times 3$ MAGIC CUBE SHOWN IN FIG. 10, AND FIVE VARIATIONS OF THE SAME.

COMBINATIONS	ADVANCE MOVES	N BREAKMOVES	N ² BREAKMOVES
A. B. C.	One cell to left in next square up	One cell in upward left-hand diagonal in next square down	One cell in downward right-hand diagonal in next square down
B. C. A.	Three consecutive cells in upward left-hand diagonal in same square	One cell in upward right-hand diagonal in next square up	Same as in A. B. C.
C. A. B.	One cell up in next square up	One cell in downward left-hand diagonal in next square up	Same as in A. B. C.
C. B. A.	Same as in B. C. A.	Same as in C. A. B.	Same as in A. B. C.
B. A. C.	Same as in A. B. C.	Same as in B. C. A.	Same as in A. B. C.
A. C. B.	Same as in C. A. B.	Same as in A. B. C.	Same as in A. B. C.

layers, forming five 5×5 squares from the top to the bottom of the cube.

Commencing with 1 in the first cell of the middle horizontal column in the third square, this cube may be constructed by filling in the various cells with consecutive numbers up to 125 in accordance with the following directions:

1.

3.

5.

67	98	104	10	36
110	11	42	73	79
48	54	85	111	17
86	117	23	29	60
4	35	61	92	123

50	51	82	113	19
88	119	25	26	57
1	32	63	94	125
69	100	101	7	38
107	13	44	75	76

3	34	65	91	122
66	97	103	9	40
109	15	41	72	78
47	53	84	115	16
90	116	22	28	59

TOP SQUARE.

BOTTOM SQUARE.

2.

4.

106	12	43	74	80
49	55	81	112	18
87	118	24	30	56
5	31	62	93	124
68	99	105	6	57

89	120	21	27	58
2	33	64	95	121
70	96	102	8	39
108	14	45	71	77
46	52	83	114	20

FIG. 12.

Advance moves. One cell up in next square down.

N breakmove. Two cells to the left and one cell down (knight's move) in same square as the last entry.

N² breakmove. One cell to right in same square as last entry.

Although this cube is not perfect it exhibits some interesting qualifications. Examining first the five horizontal squares from the top to the bottom of the cube as shown in Fig. 12, there are:

- a. 50 straight columns summing up to..... 315
- b. 10 corner diagonal columns summing up to 315
- c. 40 sub-diagonal columns summing up to.. 315

Total 100 columns having the same summation.

In the five vertical squares from front to back of the cube there are:

- 50 straight columns summing up to
- 6 corner diagonal columns summing up to
- 20 sub-diagonal columns summing up to

Total 76 columns having the same summation.

In the five vertical squares from right to left of the cube there are, as in the last case, 76 columns which all sum up to 315. In the complete cube there are also four corner diagonal columns which unite the eight corners that sum up to 315.

A table similar to Fig. 3 may be laid out giving three-figure values for the numbers in $5 \times 5 \times 5$ cubes from 1 to 125, and by changing the numbers in Fig. 12 to

TABLE II.

Prime Nos.	1	2	3	4	5	Section 1.
Key Nos.	0	5	10	15	20	
Prime Nos.	1	2	3	4	5	Section 2.
Key Nos.	25	30	35	40	45	
Prime Nos.	1	2	3	4	5	Section 3.
Key Nos.	50	55	60	65	70	
Prime Nos.	1	2	3	4	5	Section 4.
Key Nos.	75	80	85	90	95	
Prime Nos.	1	2	3	4	5	Section 5.
Key Nos.	100	105	110	115	120	

FIG 13.

Three-figure values, a square similar to Fig. 4 will be produced from which five variations of Fig. 12 may be deduced. Similar results, however, can be obtained with less labour by means of a table of key numbers constructed as in Fig. 13. (Table II.)

The three-figure values of cell numbers in $5 \times 5 \times 5$ magic cubes are found from this table as follows:

Select the key-number which is nearest to the cell—number, but *below it in value*. Then write down

1. The section number in which the key number is found,
2. The prime number over the key-number,

DIRECTIONS FOR CONSTRUCTING THE $5 \times 5 \times 5$ MAGIC CUBE SHOWN IN FIG. 12, AND FIVE VARIATIONS OF THE SAME.

COMBINATIONS	ADVANCE MOVES	N BREAKMOVES	N ² BREAKMOVES
A. B. C.	One cell up in next square down	Two cells to left and one down in same square as last entry	One cell to right in same square as last entry
B. C. A.	Two cells to left and one up for five consecutive numbers in same square	Two cells in upward left hand diagonal in next square down	Same as in A. B. C.
C. A. B.	Two cells in left hand downward diagonal in next square up	One cell in right-hand downward diagonal in next square up	Same as in A. B. C.
C. B. A.	Same as in B. C. A.	Same as in C. A. B.	Same as in A. B. C.
B. A. C.	Same as in A. B. C.	Same as in B. C. A.	Same as in A. B. C.
A. C. B.	Same as in C. A. B.	Same as in A. B. C.	Same as in A. B. C.

3. The difference between the key-number and the cell-number.

Three figures will thus be determined which will represent the required three-figure value of the cell-number.

Examples. The first number in the first row of the upper square in Fig. 12 is 67. The nearest key number to this and below it in value is 65 in section 3 under the prime number 4 and the difference between the key-number and the cell-number is 2. The three-number value of 67 is therefore 3. 4. 2. Again, the fourth number in the same row is 10. The nearest key-number but *below it in value* is 5 in section 1 under the prime number 2 and the difference between the key-number and the cell-number is 5. The three-figure value of 10 is therefore 1. 2. 5. By these simple operations the three-figure values of all the cell numbers in the $5 \times 5 \times 5$ cube in Fig. 12 may be quickly

1.

3.

5.

1	82	38	119	75
54	5	81	37	118
117	73	4	85	36
40	116	72	3	84
33	39	120	71	2

65	16	97	28	109
108	64	20	96	27
26	107	63	19	100
39	30	106	62	18
17	98	29	110	61

124	55	6	87	43
42	123	54	10	86
90	41	122	53	9
8	89	45	121	52
51	7	88	44	125

TOP SQUARE.

BOTTOM SQUARE.

2.

4.

33	114	70	21	77
76	32	113	69	25
24	80	31	112	68
67	23	79	35	111
115	66	22	78	34

92	48	104	60	11
15	91	47	103	59
58	14	95	46	102
101	57	13	94	50
49	105	56	12	93

FIG. 14.

determined, and by the system of transposition previously explained, five variations of this cube may be constructed.

The shorter method of building these $5 \times 5 \times 5$ cubes by the direct process of filling the different cells in regular order with consecutive numbers may, however, be considered by some to be preferable to the more roundabout way as seen in the table on page 400.

Fig. 14 is another example of a $5 \times 5 \times 5$ magic cube

DIRECTIONS FOR CONSTRUCTING THE $5 \times 5 \times 5$ MAGIC CUBE SHOWN IN FIG. 14, AND FIVE VARIATIONS OF THE SAME.

COMBINATIONS	ADVANCE MOVES	N BREAKMOVES	N ² BREAKMOVES
A. B. C.	Two consecutive cells in upward left hand diagonal in next square up	One cell in upward right-hand diagonal in next square up	One cell in downward right-hand diagonal in next square down
B. C. A.	Two cells down in second square down	One cell in downward left-hand diagonal in second square down	Same as in A. B. C.
C. A. B.	Two cells to right in next square up	Two cells in downward right hand diagonal in next square down	Same as in A. B. C.
C. B. A.	Same as in B. C. A.	Same as in C. A. B.	Same as in A. B. C.
B. A. C.	Same as in A. B. C.	Same as in B. C. A.	Same as in A. B. C.
A. C. B.	Same as in C. A. B.	Same as in A. B. C.	Same as in A. B. C.

which is commenced in the upper left-hand corner of the top square, and finished in the lower right-hand corner of the bottom square, the middle number of the series (63) appearing in the center cell of the cube according to rule.

Odd magic cubes may be commenced in various cells other than those shown in the preceding pages, and they may be built up with an almost infinite number of variations. It would, however, be only superfluous and tiresome to amplify the subject further, as the examples already submitted cover all the important points of construction, and may readily be applied to further extensions.

Any sizes of odd magic cubes larger than $5 \times 5 \times 5$ may be constructed by the directions which govern the formation of $3 \times 3 \times 3$ and $5 \times 5 \times 5$ cubes.

EVEN MAGIC CUBES.

Magic cubes of even numbers may be built by the aid of geometric diagrams, similar to those illustrated in a previous article, which described the construction of even magic squares.

Fig. 15 shows one of the many possible arrangements of a $4 \times 4 \times 4$ cube, the diagram of which is given in Fig. 16.

There are fifty-two columns in this cube which sum up to 130, viz., sixteen vertical columns from the top of the cube to the bottom, sixteen horizontal columns from the front to the back, sixteen horizontal columns from right to left, and four diagonal columns uniting the four pairs of opposite corners. The sum of any two numbers, which are diametrically opposite to each other and equidistant from the center of the cube also equals 65 or $n^3 + 1$.

Another feature of this cube is that the sum of the four numbers in each of the forty-eight sub-squares of 2×2 is 130.

It was shown in a previous article on magic squares

(Top.) Section I.	1	63	62	4
	60	6	7	57
	56	10	11	53
	13	51	50	16

Section II	48	18	19	45
	21	43	42	24
	25	39	38	28
	36	30	31	33

Section III.	32	34	35	29
	37	27	26	40
	41	23	22	44
	20	46	47	17

Section IV. (Bottom.)	49	15	14	52
	12	54	55	9
	8	58	59	5
	61	3	2	64

FIG. 15.

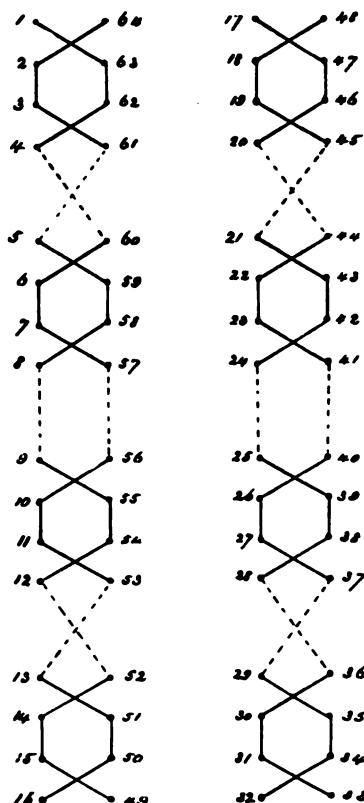


FIG. 16.

Totals = 130.

that the square of 4×4 could be formed by writing the numbers 1 to 16 in arithmetical order, then leaving the numbers in the two corner diagonals unchanged, but changing all the other numbers to their complements with 17 or $n^2 + 1$. It will be noted in the magic cube of $4 \times 4 \times 4$, given in Fig. 15, that in the first and last of the four sections (I and IV) this rule also holds good. In the two middle sections (II and III) the rule is reversed; the numbers in the two corner diagonals being complements with

65 or n^3+1 , and all the other numbers in arithmetical order.

1	2	3	4	17	18	19	20	33	34	35	36	49	50	51	52
5	6	7	8	21	22	23	24	37	38	39	40	53	54	55	56
9	10	11	12	25	26	27	28	41	42	43	44	57	58	59	60
13	14	15	16	29	30	31	32	45	46	47	48	61	62	63	64

FIG. 17.

Fig. 17 shows four squares or sections of a cube, with the numbers 1 to 64 written in arithmetical order. Those numbers that occupy corresponding cells in Fig. 15 are enclosed within circles. If all the other numbers in Fig. 17 are changed to their complements with 65, the total arrangement of numbers will then be the same as in Fig. 15.

In his interesting and instructive "Reflections on Magic Squares," (printed in the January number of *The Monist*) Dr. Paul Carus gives a novel and ingenious analysis of even squares in different "orders" of numbering, these orders being termed respectively *o*, *ro*, *i* and *ri*. It is shown that the two magic squares of 4×4 (in article referred to) consist only of *o* and *ro* numbers; *ro* numbers being in fact the complements of *o* numbers with n^2+1 . This rule also obtains in the magic cube of $4 \times 4 \times 4$ given in Fig. 15. The four sections of this cube may in fact be filled out by writing the *o* numbers, in arithmetical order in the cells of the two corner diagonal columns of sections I and IV, and in all the cells of sections II and III, excepting those of the two corner diagonal columns, and then writing the *ro* numbers, also in arithmetical order, in the remaining empty cells of the four sections.

Fig. 15 may be considered as the foundation of all magic cubes of $4 \times 4 \times 4$ and their multiples, of this class,

but a great many variations may be effected by simple transpositions. For example, Fig. 18 is a $4 \times 4 \times 4$ cube which is constructed by writing the four numbers that are contained in the 2×2 sub-squares (Fig. 15) in a straight line, and there are many other possible transpositions which will change the relative order of the numbers, without destroying the magic characteristics of the cube.

The arrangement of the numbers in Fig. 18 follows the diagrammatic order shown in Fig. 19.

Section I. (Top.)	1	63	60	6
	62	4	7	57
	56	10	13	51
	11	53	50	16

Section II.	48	18	21	43
	19	45	42	24
	25	39	36	30
	38	28	31	33

Section III.	32	34	37	27
	35	29	26	40
	41	23	20	46
	22	44	47	17

Section IV. (Bottom.)	49	15	12	54
	14	52	58	9
	8	58	61	3
	59	5	2	64

FIG. 18.

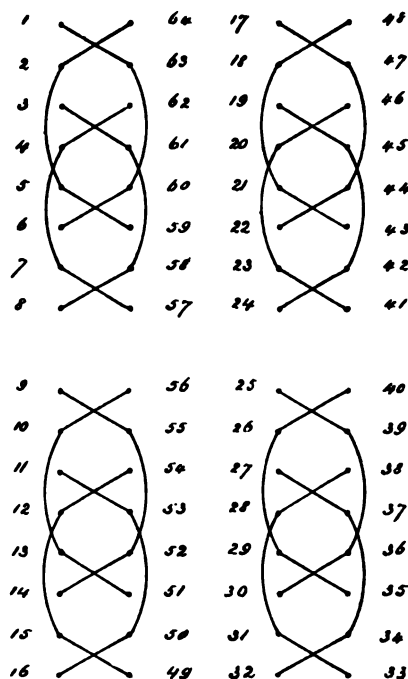


FIG. 19.

Totals = 130.

The next even magic cube is $6 \times 6 \times 6$, but the writer has been unable to construct it. He does not however regard it to be a mathematical impossibility.

The $8 \times 8 \times 8$ magic cube follows next in order. Fig. 20 shows this cube divided, for convenience, into eight sectional layers or sections, and Fig. 21 gives the diastematic order of the numbers in the first and eighth layers, the intermediate sections being built from simigrams, numbered in arithmetical order.

It will be seen from these diagrams that the $8 \times 8 \times 8$ cube is simply an expansion of the $4 \times 4 \times 4$ cube,

510	4	5	507	506	8
11	501	500	14	15	497
19	493	492	22	23	489
486	28	29	483	482	32
478	36	37	475	474	40
43	469	468	46	47	465
51	461	460	54	55	457
454	60	61	451	450	64

Section I.

384	130	131	381	380	134	135	377
137	375	374	140	141	371	370	144
145	367	366	148	149	363	362	152
360	154	155	357	356	158	159	353
352	162	163	349	348	166	167	345
169	343	342	172	173	339	338	176
177	335	334	180	181	331	330	184
328	186	187	325	324	190	191	321

Section III.

67	445	444	70	71	441
438	76	77	435	434	80
430	84	85	427	426	88
91	421	420	94	95	417
99	413	412	102	103	409
406	108	109	403	402	112
398	116	117	395	394	120
123	389	388	126	127	385

Section II.

193	319	318	196	197	315	314	200
312	202	203	309	308	206	207	305
304	210	211	301	300	214	215	297
217	295	294	220	221	291	290	224
225	287	286	228	229	283	282	232
280	234	235	277	276	281	280	273
272	242	243	269	268	246	247	265
269	263	262	252	253	269	268	256

Section IV.

(First Part.)

FIG. 20.

just as the 8×8 magic square is an expansion of the 4×4 square. In like manner all the diagrams which were given for different arrangements of 8×8 magic squares may also be employed in the construction of various $8 \times 8 \times 8$ magic cubes.

257	255	254	260	261	251	250	262
248	266	267	245	244	270	271	246
240	274	275	237	236	278	279	233
211	231	230	214	215	227	226	212
213	223	222	202	203	219	218	206
216	208	209	213	212	202	203	209
208	206	207	205	204	210	211	201
203	199	198	216	217	195	194	220

Section V.

128	316	317	125	124	390	391	121
393	119	118	396	397	115	114	400
401	111	110	404	405	107	106	408
104	410	411	101	100	414	415	97
96	418	419	93	92	422	423	89
425	87	86	428	429	83	82	422
433	79	78	436	437	75	74	440
72	442	443	69	68	446	447	65

Section VII.

192	322	323	189	188	326	327	185
329	183	182	332	333	179	178	336
337	175	174	340	341	171	170	344
168	346	347	165	164	350	351	161
160	354	355	157	156	352	353	153
361	151	150	364	365	147	146	368
369	143	142	372	373	139	138	376
136	378	379	133	132	382	383	129

Section VI.

449	63	62	452	453	59	58	456
56	458	459	53	52	462	463	49
48	466	467	45	44	470	471	41
473	39	38	476	477	35	34	480
481	31	30	484	485	27	26	488
24	490	491	21	20	496	497	17
16	498	499	13	12	502	503	9
505	7	6	508	509	3	2	512

Section VIII.

(Second Part.)

FIG. 20.

An examination of Fig. 20 will show that, like the $4 \times 4 \times 4$ cube in Fig. 15 it is built up of *o* and *ro* numbers exclusively. In sections I, IV, V, and VIII, the cells in the corner diagonal columns, and in certain other cells which are placed in definite geometrical relations thereto,

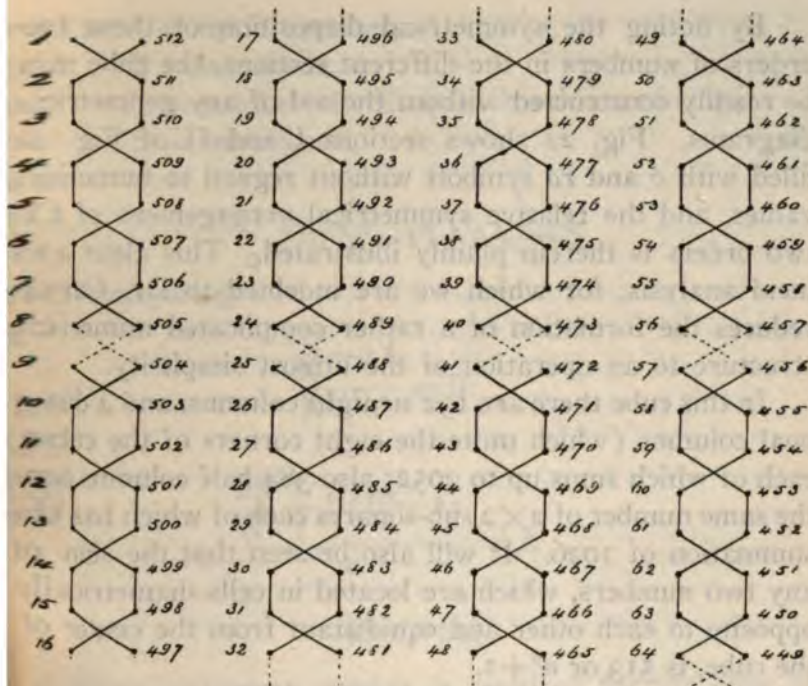


FIG. 21.

contain *o* numbers, while all the other cells contain *ro* numbers. In sections II, III, VI, and VII, the relative positions of the *o* and *ro* numbers are reversed.

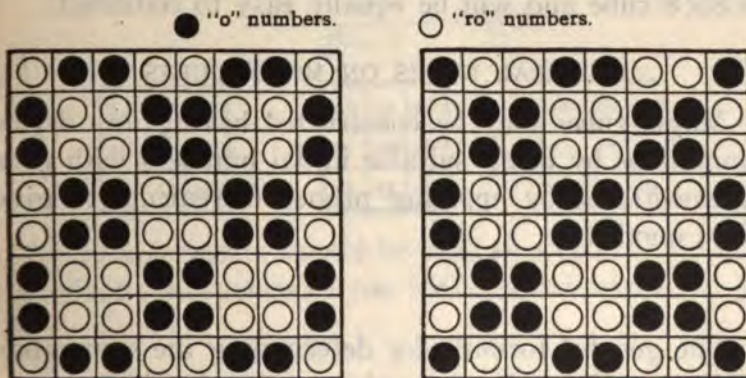


FIG. 22.

By noting the symmetrical disposition of these two orders of numbers in the different sections, the cube may be readily constructed without the aid of any geometrical diagrams. Fig. 22 shows sections I and II of Fig. 20 filled with *o* and *ro* symbols without regard to numerical values, and the relative symmetrical arrangement of the two orders is therein plainly illustrated. This clear and lucid analysis, for which we are indebted to Dr. Carus, reduces the formation of a rather complicated numerical structure to an operation of the utmost simplicity.

In this cube there are 192 straight columns, and 4 diagonal columns (which unite the eight corners of the cube) each of which sums up to 2052; also 384 half columns and the same number of 2×2 sub-squares each of which has the summation of 1026. It will also be seen that the sum of any two numbers, which are located in cells diametrically opposite to each other and equidistant from the center of the cube, is 513 or $n^3 + 1$.

As the writer has been unable to construct the $6 \times 6 \times 6$ magic cube no attempt will be made in this article to produce a $10 \times 10 \times 10$ or any larger cube of this peculiar class. The $12 \times 12 \times 12$ cube and all larger ones that are formed with multiples of 4 will naturally resemble the $8 \times 8 \times 8$ cube and will be equally easy to construct.

GENERAL NOTES ON MAGIC CUBES.

Magic cubes may be constructed having any desired summations by using suitable initial numbers with given increments, or by applying proper increments to given initial numbers.

* * *

The general formula for determining the summations or column values of magic cubes as already given on page 389 may be copied here for convenient reference.

Let A = initial number,
 B = increment,
 N = number of cells in each column of cube,
 S = summation,

then:

$$\text{I} \quad \frac{N}{2} [B(N^3 - 1) + 2A] = S$$

and transposing:

$$\text{II} \quad \frac{\frac{2S}{N} - 2A}{N^3 - 1} = B.$$

or:

$$\text{III} \quad \frac{\frac{2S}{N} - B(B^3 - 1)}{2} = A$$

EXAMPLES.

What increment number is required for the cube of $3 \times 3 \times 3$ with an initial number of 10 to produce summations of 108?

Expressing equation II in figure values:

$$\frac{\frac{2 \times 108}{3} - 2 \times 10}{3^3 - 1} = 2.$$

28	16	20
56	10	42
24	38	46

54	14	40
22	36	50
32	58	18

26	34	48
30	62	16
52	12	44

What increments should be used in a cube of $4 \times 4 \times 4$ to produce summations of 704 if the initial number is 50?

$$\frac{\frac{2 \times 704}{4} - 2 \times 50}{4^3 - 1} = 4.$$

50	298	294	62
286	70	74	274
270	86	90	258
98	250	246	110

Section I (Top).

238	118	132	226
130	218	214	142
146	202	198	158
130	166	170	178

Section II.

174	182	186	162
194	184	150	206
210	138	134	222
126	230	234	114

Section III.

242	106	102	214
94	262	266	82
98	278	282	66
290	58	54	302

Section IV (Bottom)

What initial number must be used with increments of 10 to produce summations of 1906 in a $3 \times 3 \times 3$ cube?

Expressing equation III in figure values:

$$\frac{\frac{2 \times 1906}{3} - 10(3^3 - 1)}{2} = 505\frac{1}{2}.$$

503½	753½	553½
735½	505½	665½
575½	645½	685½

Top Section.

725½	525½	655½
565½	635½	705½
615½	745½	545½

Middle Section.

685½	625½	635½
605½	765½	535½
715½	515½	675½

Bottom Section.

What initial number is required for the cube of $5 \times 5 \times 5$, with 4 as increment number, to produce summations of 1906?*

$$\frac{\frac{2 \times 1906}{5} - 4(5^3 - 1)}{2} = 133.2$$

* * *

The preceding simple examples will be sufficient to illustrate the formulæ given, and may suggest other problems to those who are interested in the subject.

It will be noted that the magic cubes which have been

* This example was contributed by Mr. D. B. Ventres of Haddam, Conn., whom the writer takes this opportunity to thank for many interesting suggestions and ideas.

described in this article are all in the same general class as the magic squares which formed the subject of previous articles.

397.2	521.2	545.2	169.2	273.2
569.2	178.2	297.2	421.2	445.2
321.2	345.2	469.2	573.2	197.2
473.2	597.2	221.2	245.2	369.2
145.2	269.2	373.2	497.2	621.2

Section I (Top).

553.2	177.2	301.2	425.2	449.2
325.2	349.2	453.2	577.2	201.2
477.2	601.2	225.2	249.2	353.2
149.2	253.2	377.2	501.2	625.2
401.2	525.2	549.2	153.2	277.2

Section II.

329.2	333.2	457.2	581.2	205.2
481.2	605.2	229.2	233.2	357.2
133.2	257.2	381.2	505.2	629.2
405.2	529.2	533.2	157.2	281.2
557.2	181.2	305.2	429.2	433.2

Section III.

485.2	609.2	213.2	237.2	361.2
137.2	261.2	385.2	509.2	613.2
409.2	513.2	537.2	161.2	285.2
561.2	185.2	309.2	413.2	437.2
313.2	337.2	461.2	585.2	209.2

Section IV.

141.2	265.2	389.2	493.2	617.2
393.2	517.2	541.2	165.2	289.2
565.2	189.2	293.2	417.2	441.2
317.2	341.2	465.2	589.2	193.2
469.2	593.2	217.2	241.2	365.2

Section V.

There are, however, many classes of magic squares and corresponding cubes which differ from these in the general

arrangement of numbers and in various minor features, while retaining the common characteristic of having similar column values. An example of this differentiation is seen in the interesting "Jaina" square described by Dr. Carus in his "Reflections on Magic Squares." Squares of this class can readily be expanded into cubes which will naturally carry with them the peculiar features of the squares.

Another class is illustrated in the "Franklin Squares," and these can also be expanded into cubes constructed on the same general principles.

The subject of magic squares and cubes is indeed inexhaustible and may be indefinitely extended. The philosophical significance of these studies has been so ably set forth by Dr. Carus that the writer feels unable to add anything in this connection, but he trusts that the present endeavor to popularize these interesting problems may some time lead to useful results.

W. S. ANDREWS.

SCHENECTADY, N. Y.

THE NUMBER π IN CHRISTIAN PROPHECY.

RELIGION everywhere consists of that set of sentiments which is inspired by man's world-conception, and the great significance of religion appears in its application to conduct, especially toward the powers that are supposed to sway our destinies. Religion, accordingly, is the product of the most impressive knowledge of the age in which its doctrines have originated, and being of a conservative nature, it is natural for it to always lag behind the progress of the times. Authority is a great factor in religion; and thus it happens that established authority which cannot but be the authority of the past, predominates over the authority of the present, represented in the maturest knowledge of the day.

How much of the science of a very distant past is contained in some of the factors that shaped Christianity, will appear from the following consideration of the echo of mathematical knowledge which has reached us in mystical and distorted prophecies, while the original idea is still traceable in the different modes of its manifestations. It is the number of the cycle of an age, or any time represented by a circle, in which life begins a new era repeating cyclical events.

The most obvious cycle in the course of earthly affairs is the year, and the events of one year approximately predict the happenings of all others. The same may be said of the phases of the moon and of the daily course of the sun.

Time rolls in cycles, and the most significant number for calculating the length of a cycle is the number which represents the relation of the diameter of a circle to its circumference. This number, which since the days of Greece has been called π (as the initial of the Greek word *periphēreia**) was approximated in very primitive times in the number $3\frac{1}{2}$ or seven halves, and it is rather surprising that our biblical exegetists have not stumbled on it in the explanation of the several passages which have so far proved a perplexity to interpretation. In fact, the writer of these lines once communicated his suggestion to a very prominent scholar of eschatological literature, who discarded it with an incredulous smile, declaring that evidence was missing. Yet any one who will consider the several passages in question will agree that the number $3\frac{1}{2}$ which is met with so frequently in the book of Daniel, the Revelation of St. John, and other prophetic books (especially those that deal with eschatological subjects) can only refer to the number of the cycle, and it can scarcely be doubted that *three times and a fraction* as well as *after three days* which means three full days and a little more, are nothing else but expressions of the same idea.

It seems that most of the prophets firmly believed in the reliability of the number π , counted as $3\frac{1}{2}$ (or approximately $3\frac{1}{2}$) and their difficulties consisted simply in their attempts to make their calculations agree with facts. They were not sure whether to compute the number of a period in hours, days, months, lunar years or solar years; whether or not to consider leap-days and leap-months etc., but the idea of the number of the cycle is obviously uppermost in their minds in all their mystical references to any periods of time.

The number of the cycle is expressed in a mysterious form as $1+2+\frac{1}{2}$. It is unity plus duality plus unity

* περιφέρεια.

divided by duality. In another place it is called "one thousand three hundred and three score days," which is simply three and a half years when the year is counted according to ancient Babylonian fashion as 360 days, the five and a fraction additional days being considered super-numerary.

In the Revelation of St. John (xi, 3) we read:

"And I will give power unto my two witnesses, and they shall prophesy a *thousand two hundred and three score* days, clothed in sackcloth."

The same story continues, with reference to another period of three days and a half (verses 7, 9 and 11):

"When they shall have finished their testimony, the beast.... shall overcome them and kill them.... And they of the people and kindreds and tongues and nations shall see their dead bodies *three days and an half*, and shall not suffer their dead bodies to be put in graves.... And after *three days and an half* the Spirit of life from God entered into them, and they stood upon their feet."

In Daniel xii. 7 we read concerning the period of Israel's tribulation:

"And I heard the man clothed in linen, which was upon the waters of the river, when he held up his right hand and his left hand unto heaven, and sware by him that liveth for ever that it shall be for *a time, times, and an half*; and when he shall have accomplished to scatter the power of the holy people, all these things shall be finished."

"A time, times, and an half" are three and a half, (the plural "times" standing for the simplest plural number which is "two"), the same period that is allotted, as a respite from the persecutions of the dragon, to the woman who is to bear the apocalyptic Christ (Rev. xii, 14). There we read:

"And to the woman were given two wings of a great eagle, that she might fly into the wilderness, into her place, where she is nourished for *a time, and times, and half a time*, from the face of the serpent."

The woman is persecuted by the dragon and stays in the desert 1260 days, which, as we have seen, is three years and a half.

The number π appears frequently in the Apocryphal books, especially the book of Enoch, and the fourth book of Esdras. In Esdras xiv, 10 ff., the number $10\frac{1}{2}$ plays the same part and this is simply a multiple of $3\frac{1}{2}$ by 3.

The numbers 1290, 1335 and 2300 which also occur in various prophecies, are only other computations of the number of the cycle on the basis of different principles. The last mentioned is found in Daniel viii, 14, where we read:

"And he said unto me, Unto *two thousand and three hundred days*; then shall the sanctuary be cleansed."

The translation here is not exact, and perhaps cannot be, for the text is corrupt and there are many variants. At any rate 2300 days would be twice three years and a fraction, if the moon year is made the basis of calculation, and so contains the number π . But according to one variant (preferred by Professor Hilgenfeld*) the meaning appears to be "2300 evenings and mornings," implying that there are 1150 days in which the sanctuary shall remain uncleansed.

The number π (three and a fraction) is expressed in the phrase "after three days," and with this idea it is also mentioned in the book of Jonah where we read (i. 17) that the prophet "was in the belly of the fish *three days and three nights*." He came out after three full days and nights, viz., on the fourth day, and the incident is referred to by Jesus himself when prophesying his resurrection (Matt. xii. 40):

* For Professor Hilgenfeld's view on the subject see *Die jüdische Apokalyphe*, pp. 32-33. Though he repeatedly mentions prophecies containing the number $3\frac{1}{2}$, it is strange that he never thinks of its being the number of the cycle.

"For as Jonas was *three days and three nights* in the whale's belly; so shall the Son of man be *three days and three nights* in the heart of the earth."

Paul says similarly in Corinthians xv. 4, "he rose again ~~the~~ third day," but here we must bear in mind that a variant reads "after the third day," and it is very probable that ~~the~~ now rejected variant is the original reading. It is natural that as soon as Sunday had come to be regarded as the day of resurrection, and Friday was celebrated as ~~the~~ crucifixion day, the alteration should be made to conform to established church festivals.

Mathematical knowledge, so very important in ancient Babylon, was not cultivated among the early Christians, and hence the original meaning of the number three and a fraction had faded from their minds. Otherwise the Christian church festivals would probably have been so adjusted as to make the period of Christ's sojourn in the domain of death, conform to the traditional notion of a cycle. Christ's death might have been ascribed to Wednesday, or his resurrection to Tuesday, but the former would have disassociated this event from the paschal feast, while the latter would have canceled the only sanction for Christians to celebrate Sunday.

If Christ's own prophecy did not contain the quotation from Jonah, it would most probably have been modified by copyists so as to suit the established church ritual. The accessibility of the original passage preserved the text in spite of the non-conformity with the established fixation of days.

It was highly significant to the early Christians that Christ died as the paschal lamb, and so the Gospels reiterate the statement that the passion took place in the beginning of the paschal feast. A little later when the Lord's Supper began to be celebrated in commemoration of Christ's death, the Saviour was naturally regarded as the

founder of the rite which necessitated the assumption of his having the paschal meal with his disciples. This would fix the date of the crucifixion on Saturday, and reduce Christ's sojourn in hell to one night only, for if there was a thing regarded as firmly established in the Gentile church, it was the belief that the Saviour had risen on a Sunday.

Persian influences, we must remember, were very strong among the Jews of post-exilic times, and the pious sectarians were greatly affected by them. Sunday was then the great festive day of the Mithraists, and the disciples of St. John as well as the Nazarenes celebrated the day by coming together and breaking bread in a common meal. Accordingly, Sunday, the day of Mithras, was considered the fittest day to become the day of the Lord, just as the birthday of Mithras was selected as the most appropriate day for the celebration of Christ's birthday. That Sunday was celebrated prior to Christianity is unquestionably proved by the fact that St. Paul visits in the several cities those circles of "disciples" who had neither heard of the Holy Ghost, nor believed as yet on Christ Jesus (Acts xix. 1-4), and they used to break bread in common on the first day of the week.*

A compromise between these colliding considerations resulted in setting aside Christ's prophecy "after three days"; but since a dim awe of the significance of the number three was still haunting the imagination of the early Church, the phrase, "after three days" was replaced by the words "on the third day" which suited the occasion, and though it meant something different from the ancient formula, still preserved the mystic ring.

It would become monotonous to follow up all the mys-

* Cf. also Acts xviii. 25. Simon Magus and Apollos were preachers of a religion that had much in common with Paul's Christianity, but neither of them had heard of Jesus. We must assume that they had many beliefs and customs in common with the early Christians.

tical computations that have been employed to calculate the several periods which were of importance to the religious minds of that age of messianic expectations, but we may be sure that almost everywhere there lurks an approximation of the number π at the bottom of all designations of time which represent a cycle of some kind; the time of tribulation, the time of the desecration of the temple, the time of the triumph of the enemies of Israel, the time of death before resurrection, etc. It is not impossible even, that the millennium is merely the multiplication of a period of 300 day-years by three and a fraction, resulting in the round number 1000, analogous to the computation of 3 times $3\frac{1}{2}$, occurring in Esdras.

To us of a later generation, these calculations have become unmeaning, and it is perhaps hard to understand how they could have possessed so much significance to the authors of Daniel, Esdras and the Revelation. We must bear in mind, however, that the underlying principle of this antiquated logic is not wrong and is still recognized by modern science; it is simply the thought that all events are subject to law, and that by knowing the law, we can presage what the future will reveal.

EDITOR.

CRITICISMS AND DISCUSSIONS.

MAGIC SQUARES AND PYTHAGOREAN NUMBERS.

"I have compiled this discourse, which asks for your consideration and pardon not only because the matter itself is by no means easy to be handled, but also because the doctrines herein contained are somewhat contrary to those held by most of the Platonic philosophers." *Plutarch.*

The fascinating series of articles upon "Magic Squares" by Mr. W. S. Andrews and the interesting "Reflections" upon the same by the Editor in recent numbers of *The Monist* have induced me to make a few comments upon a subject in which I have long been interested,—that of the relationship between magic squares and certain Pythagorean numbers.

The mysterious relationships of numbers have attracted the minds of men in all ages. The many-sided Franklin, whose 200th anniversary the philosophical, scientific, and literary worlds have recently celebrated, used to amuse himself with the construction of magic squares and in his memoirs has given an example of his skill in this direction, by showing a very complicated compound square with the comment that he believes the same to be the most magical magic square yet constructed by any magician. I would therefore attribute the discovery of compound magic squares to Franklin rather than to Professor Schubert as suggested by Mr. Andrews.

That magic squares have had in centuries past a deeper meaning for the minds of men than that of simple mathematical curios we may infer from the celebrated picture by Albert Dürer entitled "Melancolia," engraved in 1514. The symbolism of this engraving has interested to a marked degree almost every observer. The figure of the brooding genius sitting listless and dejected amid her uncompleted labors, the scattered tools, the swaying balance, the flow-

ing sands of the glass, and the magic square of 16 beneath the bell, —these and other details reveal an attitude of mind and a connection of thought, which the great artist never expressed in words, but left for every beholder to interpret for himself.



MELANCHOLY.

The discovery of the arrangement of numbers in the form of magic diagrams was undoubtedly known to the ancient Egyptians and this may have formed part of the knowledge which Pythagoras brought back from his foreign travels. We have no direct evidence

that the Pythagorean philosophers in their studies of the relationship of numbers ever combined them into harmonic figures, yet the supposition that they did so is not at all improbable. Such diagrams and their symbolic meanings may well have formed part of the arcana of the esoteric school of Pythagoras, for similar facts were accounted by ancient writers as constituting a part of the aporrheta of the order and the story is told of an unworthy disciple who revealed the secret of the construction of the dodecahedron inscribed within a sphere, this being a symbol of the universe.

Among the best expositions of the Pythagorean philosophy are sections of the "Timæus" and "Republic" of Plato. These dialogues were written after Plato's return from Magna Græcia, where from contact with Archytas of Tarentum and other philosophers, he imbibed so much of the Italian school that his whole system of philosophy became permeated with Pythagorean ideas. It is even suggested that he incorporated into these dialogues parts of the lost writings of Philolaus, whose works he is known to have purchased. No portions of the dialogues named have been more puzzling to commentators than the vague references to different numbers, such as the number 729, which is chosen to express the difference between the kingly man and the tyrant, or the so-called number of the State in the "Republic," or the harmonic number of the soul in the "Timæus" of which Plutarch said that "it would be an endless toil to recite the contentions and disputes that have from hence arisen among his interpreters." Either our text of these passages is corrupt or Plato is very obscure, throwing out indirect hints which would be intelligible only to those previously informed. Plato states himself in the "Phædrus" that "all writings are to be regarded purely as a means of recollection for him who already knows," and he, therefore, probably wrote more for the benefit of his hearers than for distant posterity.

It is upon the principle of a magic square that I wish to interpret the celebrated passage in the "Republic" referring to the number 729, proceeding from this to a discussion of certain other numbers of peculiar significance in the Pythagorean system. My efforts in this direction are to be regarded as purely fanciful; the same may be said, however, of the majority of other methods of interpretation.

The passage from the "Republic" referred to (Book IX, § 587-8, Jowett's translation) reads as follows:

Socrates. "And if a person tells the measure of the interval which separates the king from the tyrant in truth of pleasure, he

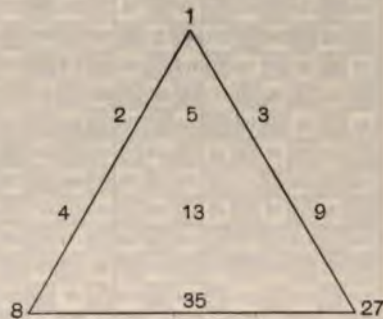
will find him, when the multiplication is completed living 729 times more pleasantly, and the tyrant more painfully by this same interval."

Glancon. "What a wonderful calculation."

Socrates. "Yet a true calculation and a number which closely concerns human life, if human life is concerned with days and nights and months and years."

The number 729 is found to be of great importance all through the Pythagorean system. Plutarch states that this was the number belonging to the sun, just as 243 was ascribed to Venus, 81 to Mercury, 27 to the moon, 9 to the earth, and 3 to Antichthon (the earth opposite to ours). These and many similar numbers were derived from one of the progressions of the Tetractys,—1:2::4:8 and 1:3::9:27. The figures of the above proportions were combined by Plato into one series 1, 2, 3, 4, 9, 8, 27. ("Timæus," § 35). Plutarch in his "Procreation of the Soul," which is simply a commentary upon Plato's "Timæus," has represented the numbers in the form of a triangle; the interior numbers, 5, 13, and 35, representing the sums of the opposite pairs, were also of great importance.

The deep significance of the Tetractys in the system of Pythagoras may be inferred from a fragment of an oath contained in the "Golden Verses."



Ναὶ μὰ τὸν ἀμέτερον ψυχῇ παραδόντα τετρακτὸν
Παγὰν, ἀενάου φύσεως ῥιζώματ' ἔχουσαν.

"Yea, by our Tetractys which giveth the soul the fount and source of ever flowing nature!"

Odd numbers were especially favored by the Pythagoreans and of these certain ones such as 3 and its higher powers were considered to have a higher significance than others and in this way, perhaps, arose the distinction between expressible and inexpressible or ineffable numbers (*ἀριθμοὶ ῥητοὶ καὶ ἄῤῥητοι*). Numbers which expressed some astronomical fact also held high places of honor, as may be seen from a statement by Plutarch (*loc. cit.*) in reference to the Tetractys. "Now the final member of the series, which is 27, has this peculiarity, that it is equal to the sum of the preceding numbers (1+2+3+4+9+8); it also represents the periodical num-

ber of days in which the moon completes her monthly course; the Pythagoreans have made it the tone of all their harmonic intervals."

This passage indicates sufficiently the supreme importance of the number 27.

If we construct a magic square 27×27 upon the plan of a

352	381	326	439	468	413	274	303	248	513	642	587	700	729	674	535	564	509	118	147	92	205	234	179	40	53	14
327	353	379	414	440	466	249	275	301	589	614	640	675	701	727	510	536	562	83	119	145	180	206	232	15	41	67
380	325	354	467	412	441	302	247	276	641	586	615	728	673	702	563	508	537	146	91	120	233	178	207	68	12	42
277	306	251	365	384	329	433	482	407	538	567	512	616	645	590	694	723	668	43	72	17	121	150	95	195	228	71
252	278	304	330	356	382	408	434	460	513	539	565	591	617	643	669	695	721	18	44	70	96	122	148	174	200	226
305	250	279	383	328	357	461	405	435	566	511	540	644	589	618	722	667	696	71	16	45	149	94	123	227	172	201
436	465	410	211	300	245	358	387	332	597	726	671	532	561	506	619	648	593	202	231	176	37	66	11	124	153	88
411	437	463	246	212	298	333	359	385	672	698	724	507	533	559	594	620	646	177	203	229	12	38	64	99	125	151
484	409	438	299	244	273	386	331	360	725	670	699	560	505	534	647	592	621	230	175	204	65	10	35	152	97	123
127	156	101	214	243	188	49	78	23	361	390	335	448	477	422	283	312	257	595	624	569	682	711	656	517	546	491
102	128	154	189	215	241	24	50	76	336	362	388	423	449	475	258	284	310	570	596	622	657	683	709	492	519	544
155	100	129	242	187	216	77	22	51	389	334	363	476	421	450	311	256	285	623	568	597	710	655	684	545	490	515
52	81	26	130	159	104	208	237	182	286	315	260	364	393	338	442	471	416	520	549	484	598	627	572	676	705	650
27	53	79	105	131	157	183	209	235	261	287	313	339	365	391	417	443	469	495	521	547	573	599	625	651	677	703
80	25	54	158	103	132	236	181	210	314	259	288	392	337	366	470	415	444	548	493	522	626	571	600	704	649	678
211	240	185	46	75	20	133	162	107	445	474	419	280	309	254	367	396	341	678	708	653	514	543	488	601	630	575
186	212	238	21	47	73	108	134	160	420	446	472	255	281	307	342	368	394	654	680	706	489	515	541	576	602	628
239	184	213	74	19	48	161	106	135	473	418	447	308	253	282	395	340	369	707	652	681	542	487	516	629	574	603
604	533	578	691	720	665	526	555	500	199	138	83	196	225	170	31	60	5	370	399	344	457	486	431	292	321	266
579	605	631	666	692	718	501	527	553	84	110	136	171	197	223	6	32	58	345	371	397	432	458	484	267	293	319
632	577	608	719	664	693	554	499	528	137	82	111	224	169	198	59	4	33	398	343	372	485	430	459	320	265	294
529	558	503	607	636	581	695	714	659	34	63	8	112	141	86	180	219	164	295	324	269	373	402	347	451	480	425
504	530	556	592	608	634	660	686	712	9	35	61	87	113	139	165	191	217	270	296	322	348	374	400	426	452	478
557	502	531	635	590	609	713	658	687	62	7	36	140	85	114	218	163	192	323	268	297	401	346	375	479	424	453
688	717	662	523	552	497	610	639	584	193	222	167	28	57	2	115	144	89	454	483	428	289	318	263	376	405	350
663	689	715	498	524	550	585	611	637	168	194	220	3	29	55	90	116	142	425	455	481	284	290	316	351	377	423
716	691	680	551	496	525	638	583	612	221	166	195	56	1	30	143	88	117	482	427	456	317	282	291	404	349	378

checker-board—arranging the numbers 1 to 729 first in numerical order, then shifting the 9 largest squares (9×9) into the positions indicated in the familiar 3×3 square, repeating the process with the subdivisions of the 9×9 squares and so on down—we will arrive at the following combination.¹

It will be noted that we have 365 white squares or days and

¹ This method of constructing compound magic squares is, so far as I know, original with the writer. It bears some resemblance to the method of Schubert (*Monist*, XV, p. 566); the numbers of each square, however, increase in periods of threes instead of by sequence.

364 dark squares or nights—a veritable “checkerboard of nights and days.” The number 365, the days of the solar year, very appropriately occupies the centre of the system. The columns, horizontals, and diagonals of the central square 3×3 foot up 1095, or the days of a 3 year period, those of the larger center square 9×9 foot up 3285 the days of a 9 year period, while those of the entire combination 27×27 foot up 9855,² the days of a 27 year period,—in other words, periods of years corresponding to the Tetractys 1, 3, 9, 27. We may with safety borrow the language of Plato and say that the above arrangement of numbers “is concerned with days and nights and months and years.”

The interpretation of the other passage referred to in the “Republic”—the finding of the number of the State—(Book VIII, § 546) has been a subject of the greatest speculation and by consulting the various editions of Plato it will be found that scarcely any two critics agree upon a solution.³ As Jowett remarks, it is a puzzle almost as great as that of the Beast in the Book of Revelation. Unfortunately we have no starting-point from which to begin our calculations; this and the very uncertain meanings of many of the Greek terms have caused many commentators to give up the solution of the problem in sheer despair. Aristotle, who was a hearer of Plato's, writes as if having a full knowledge of the mystery; Cicero, however, was unable to solve the riddle and his sentiment became voiced in the proverb *numeris Platonis nihil obscurius*.

By taking a hint from our magic square and starting with the number 27, I believe we may arrive at as good a solution of the problem as any that I have seen suggested. The following interpretation of the Greek terms is offered.

αὐξήσεις δυνάμεναι τε καὶ δυναστεύμεναι	the square of the number times its root,	$27^2 \times \sqrt[3]{27} = 2187$
ρεῖς ἀποστάσεις	increased by thrice the first terms (of the Tetractys)	$(1+2+3+4+9) \times 3 = 57$
-ἑτταρας δὲ ὅρους λαβοῦσαι	and four times the whole series	$(1+2+3+4+9+8+27) \times 4 = 216$

² Not only the perpendiculars, horizontals, and diagonals of this large square foot up 9855, but there are an almost indefinite number of zig-zag lines, which give the same footing.

³ Schleiermacher, Donaldson, and Schneider suggest 216, and much may be said in favor of this number. Jowett gives 8000 as the possible solution. Others suggest 951, 5040, 17,500, 1728, 10,000, etc.

ὁμοιούντων τε καὶ ἀνο-
μοιουντων καὶ αὐξόντων
καὶ φθινόντων

of numbers unlike yet
bearing the same ra-
tio whether increas-
ing or decreasing

[carried over from last page] 2460

(i. e. 1:2::4:8 or 8:4::2:1 It may also refer
to the ascending and descending figures
of the triangle. 8, 4, 2, 1, 3, 9, 27)

πάντα προσήγορα καὶ ῥητὰ
πρὸς ἀλλήλα ἀπέφηναν

makes the sum com-
mensurable and ex-
pressible in all its
parts.

sum = ~~2460~~

(i. e. 2460 is easily divisible by 1, 2, 3, 4, 5,
6, 10, 12, etc.)

ὡν ἐπιτρισὶς πυθμῆν,

this sum increased by
 $\frac{1}{2}$

$$2460 \times 1\frac{1}{2} = 3690$$

πεντάδι συζυγίς

and adding 5

$$3690 + 5 = 3695$$

τρὶς αὐξηθεὶς

is multiplied by 3

$$3695 \times 3 = 9855$$

This solution of the problem, 9855, it will be noted, brings us again but by a different route to the magic number of our large square. The second part of the passage contains a description of the number by which the above calculation may be verified.

δύο ἁρμονίας παρέχεται

(the number) yields
two harmonic parts,

τὴν μὲν ἰσὴν ἰσάκεις,

one of which is a
square

$$3 \times 3 = 9$$

ἐκατὸν τοσαντάκις,

multiplied by 100:

$$9 \times 100 = 900$$

τὴν δὲ ἰσομήκη μὲν,

the other has one side
equal to the square

3

τῇ προμήκει δὲ,

and the other oblong

$$3 \times 2985 = 8955$$

sum = 9855

The remainder of the passage describes the length of the oblong which we have shown above to be 2985:

ἐκατὸν μὲν ἀριθμῶν ἀπὸ
διαμέτρων πεμπάδος,

(the oblong) is 100
times the side of a
rectangle having di-
agonals of 5.

$$100 \times 3 = 300$$

(i. e. having sides of 3 and 4.)

σητῶν δεομένων ἐνὸς ἐκάσ-
των,

less of one each of the
expressible parts, i. e.
4 and 5

ἀρρήτων δὲ δυνειν,	and 2 of the inexpressible	$300 - (5 + 4 + 3 + 3) =$	285
ἑκατὸν δὲ κύβων τριάδος	plus 100 times the cube of 3	$(3)^3 \times 100 =$	2700
		sum =	2985

Plato states that the number of the State "represents a geometrical figure which has control over the good and evil of births. For when your guardians are ignorant of the right seasons and unite bride and bridegroom out of due time, the children will not be goodly and happy." The number 9855, expressing a period of 27 years, might thus represent the dividing line between the ages when men and women should begin to bear children to the State,—20-27 years for women, 27-34 years for men. (See also "Republic," Book V, § 460). Aristotle in his "Politics" (V, 12. 8) says in reference to the number of the State that when the progression of number is increased by $\frac{1}{3}$ and 5 is added, 2 harmonies are produced giving a solid diagram. This, as may be seen from our analysis of the first part of the passage, may have reference to the number 3285, which, being represented by $3^2 \times 365$, may be said to have the dimensions of a solid.

In the January number of *The Monist* the Editor gave some very striking examples of the relationship between magic squares and the musical figures of Chladni. I would like to touch before concluding upon a closely related subject and show certain connections which exist between the magic square, which we have constructed, and the numbers of the Pythagorean harmonic scale. This scale had, however, more than a musical significance among the Greek philosophers; it was extended to comprehend the harmony of planetary movements and above all else to represent the manner in which the "soul of the universe" was composed. It is especially in the latter sense that Plato employs the scale in his "Timæus."

In a treatise by Timæus the Locrian upon the "Soul of the World and Nature," we find the following passage: "Now all these proportions are combined harmonically according to numbers, which proportions the demiurge has divided according to a scale scientifically, so that a person is not ignorant of what things and by what means the soul is combined; which the deity has not ranked after the substance of the body...., but he made it older by taking the *first of unities* which is 384. Now of these the first being assumed it is easy to reckon the double and triple; and all the terms, with

their complements and eights must amount to 114,695." (Translation by Burge.)

Plato's account of the combination of the soul is very similar to the above, though he seems to have selected 192, $(384/2)$ for the first number. Plutarch in his commentary makes no mention of Timæus, but states that Crantor⁴ was the first to select 384, for the reason that it represented the product of $8^2 \times 6$, and is the lowest number which can be taken for the increase by eighths without leaving fractions. Another very possible reason, which I have not seen mentioned, is that 384 is the harmonic ratio of $27^2/2$ or 364.5, a number which expresses very closely the days of the year.

$$243:256::364.5:384.$$

The proportion $243:256(3^5:4^4)$ was employed by the Pythagoreans to mark the ratio⁵ which two unequal semitones of the harmonic scale bear to one another.

Batteux has calculated the 36 terms of the Pythagorean scale starting with 384 and his series must be considered correct, for it fulfils the conditions specified by Timæus,—the numbers all footing up 114,695: A few of the numbers of this harmonic scale marking the "first unity" and several of the semitones will be given.

1st octave	{	E	384	(For Batteux' full series and method of calculation the reader is referred to Burge's translation of Plato Vol. VI. p. 171).
		C	486	
		F	729	
2nd octave	{	C	972	
		F	1458	
3rd octave	{	C	1944	
		B-flat	2187	
4th octave		B-flat	4374	

By referring to our magic square it will be noted that the *first of unities*,⁶ 384, constitutes the magic number of the small 3×3 square beginning with the number 100. If we arrange the magic numbers of the 81 squares (3×3) in the order of their magnitudes we find that they fall into 9 series of 9 numbers, each series beginning as follows:

I	II	III	IV	V	VI	VII	VIII	IX
87	330	573	816	1059	1302	1545	1788	2031

⁴ Crantor lived nearly 100 years after Timæus the Locrian. The treatise upon the "Soul of the World and Nature," which bears the latter's name probably belongs to a much later period.

⁵ for further references to this ratio see Plato's "Timæus," § 36, and Plutarch's "Procreation of the Soul," § 18.

The intervals between these series are worthy of note.

INTERVALS.

Between I and II	243	the first member of the ratio 243:256.
" I " III	486	C of the 1st octave
" I " IV	729	F " " 1st "
" I " V	972	C " " 2nd "
" I " VII	1458	F " " 2nd "
" I " IX	1944	C " " 3rd "

If we arrange the magic numbers of the large squares (9×9) the same way, it will be found that they fall into 3 series of 3 numbers, each series beginning

I	II	III
1017	3204	5391
Interval between I and II = 2187 B-flat of the 3rd octave.		
" " I " III = 4374	B-flat " " 4th "	

Numerous other instances might be given of the very intimate connection between magic squares and various Pythagorean numbers, but these must be left for the curious-minded to develop for themselves. Such connections as we have noted are no doubt in some respects purely accidental, being due to the *intrinsic harmony* of numbers and therefore not implying a knowledge by the ancients of the harmonic arrangement of the magic squares as we now know them. The harmonic arrangement of the Greeks of numbers in geometrical forms both plane and solid may, however, be accepted, and Plato's descriptions of various numbers obscure and meaningless as they were to succeeding generations, may have been easily comprehended by his hearers when illustrated by a mathematical diagram or model.⁶

Differences between the methods of notation in ancient and modern times have necessarily produced differences in the conception of numerical relations. The expression of numbers among the Greeks by letters of the alphabet was what led to the idea that every name must have a numerical attribute, but the connection of the letters of the name was in many cases lost, the number being regarded as a pure attribute of the object itself. A similar confusion of symbols arose in the representation of various concepts by geometrical forms, such as the five letters of YTEIA and the symboliza-

⁶The description of the number of the State in the "Republic" and that of the Soul in the "Timæus" render such a mode of representation almost necessary. Plutarch ("Procreation of Soul," § 12) gives an illustration of an harmonic diagram 5×7 containing 35 small squares "which comprehends in its subdivisions all the proportions of the first concords of music."

tion of health by the Pythagoreans under the form of the pentagon or five-pointed star.

It was the great defect of the Greek schools that in their search for truth, methods of experimental research were not cultivated. Plato in his "Republic" (Book VII, § 530-531) ridicules the empiricists, who sought knowledge by studying the stars or by comparing the sounds of musical strings, and insists that no value is to be placed upon the testimony of the senses. "Let the heavens alone and train the intellect" is his constant advice.

If the examples set by Pythagoras in acoustics and by Archimedes in statics had been generally followed by the Greek philosophers, our knowledge of natural phenomena might have been advanced a thousand years. But as it happened there came to prevail but one idea intensified by both Plato and Aristotle, and handed down through the scholastics even to the present time, that knowledge was to be sought for only from within. Hence came the flood of idle speculations which characterized the later Pythagorean and Platonic schools and which eventually undermined the structure of ancient philosophy. But beneath the abstractions of these schools one can discover a strong undercurrent of truth. Many Pythagoreans understood by number that which is now termed natural law. Such undoubtedly was the meaning of Philolaus when he wrote "Number is the bond of the eternal continuance of things," a sentiment which the modern physicist could not express more fittingly.

As the first study of importance for the youth of his "Republic," Plato selected the science of numbers; he chose as the second geometry and as the third astronomy, but the point which he emphasized above all was that these and all other sciences should be studied in their "mutual relationships that we may learn the nature of the bond which unites them." "For only then," he states, "will a pursuit of them have a value for our object, and the labor, which might otherwise prove fruitless, be well bestowed." Noble utterance! and how much greater need of this at the present day with our complexity of sciences and tendency towards narrow specialization.

In the spirit of the great master whom we have just quoted we may compare the physical universe to an immense magic square. Isolated investigators in different areas have discovered here and there a few seemingly restricted laws, and paying no regard to the territory beyond their confines, are as yet oblivious of the great pervading and unifying Bond which connects the scattered parts

and binds them into one harmonious system. Omar, the astronomer-poet, may have had such a thought in mind, when he wrote:

"Yes; and a single Alif were the clue—
 Could you but find it—to the treasure-house
 And peradventure to the Master too;
 Whose secret presence, through creation's veins
 Running quicksilverlike eludes your pains;" etc.

When Plato's advice is followed and the "mutual relationships between our sciences" are understood we may perchance find this clue, and having found it be surprised to discover as great a simplicity underlying the whole fabric of natural phenomena as exists in the construction of a magic square.

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NEW ORLEANS, LA.

THOUGHTS ON TIME, SPACE, AND EXISTENCE.*

I.

All existence is one. Every thing that is, is part of the All. That all of the parts are adjusted to each other, and work in harmony, proves the relationship of all the parts to the whole, and the unity of the All.

Existence extends, and existence endures. While it endures there is an unending and unceasing succession of events occurring.

When we mentally think away all of the features of existence except the feature of extension, that feature which remains when all the rest are thought away, forms, in consciousness, the conception we term space. Space, then, is abstracted mentally from reality, and in so far is a mental existence. But in reality itself, space, or the property of extension can not be separated from existence. We think of it as a thing in itself, or by itself, but this is not the

* A great many of the ideas expressed in this article have been obtained by a study of the philosophical works of Dr. Paul Carus, and I wish to give proper credit for numerous expressions and quotations which I can not well avoid using. Prior to my study of his writings, my philosophical studies had been confined mostly to the works of Herbert Spencer. While I had in a certain degree noticed that he overlooked the importance of the formal and the subjective features of existence, my ideas along these lines were very hazy and undeveloped. I supposed, that in his philosophy, finality had indeed been reached. However, when I began to study the works of Dr. Carus, a new world was opened to my view.

case. It is merely the property of extension belonging to actual existence, mentally separated, or abstracted from the All.

Duration, of itself, does not exist in reality. It is the property of existence, by which the All endures. When we mentally abstract or separate from existence the feature of duration, and think away every other feature of existence, that which remains, forms, in consciousness, the conception we term time. Time, however, does not exist, and can not exist as separated from existence. It is not an entity of, or by itself. It is abstracted from that feature of existence which events occupy, and bears the same relation to events that space does to the material element of existence. By material element I do not here mean ponderable matter only, but the ether as well.

Events, however, are always a motion of some kind; therefore, time bears the same relation to motion that space does to matter. Time, to consciousness, seems to be that which events fill; space, that which matter fills. Time is the blank form which events fill with the events mentally removed. Space is the blank form which matter fills, with the matter mentally removed. In so far, time and space are mental forms, or forms of thought.

Time, then, is an abstract from motion; and space is an abstract from matter. But motion and matter do not exist in nature as separated from each other, or from the rest of existence. There is no motion except as something moved, and this something we call matter. There likewise is nothing moved without there is motion. Neither does any matter exist that is not in motion. There is thus no motion without matter, no matter without motion.

The abstracts, time and space, must then be intimately connected, as they are both abstracted from these two intimately connected features—or, rather, abstracts of existence; for we can truly say matter and motion are both abstracts from one reality.

Let time be represented in consciousness by a straight line. It must be remembered, however, that this line is a symbol, and is not actual time itself. However, in dealing with time, it seems necessary for the sake of simplicity, to use a mental symbol to represent it; owing to the difficulty of dealing with actual time itself, and of representing time in consciousness as it actually is.

Time has extension in one direction only. This is also true of a straight line. We can therefore say each has dimension in one direction; each is a system of first degree. The line representing time may be represented as in motion, passing continuously in the

direction of its length. It must also be represented as moving with a uniform and steady motion.

Time being abstracted from motion, can be measured and in fact is measured, by motion of some kind. Dr. Carus says, "Time is merely the measure of motion." We can also say motion is the measure of time. The simple means of a swinging pendulum is one example. If we represent this motion by a point moving or oscillating in space in a straight path, each portion of time will be represented by a straight line. Now, as each portion of time can thus be represented by a straight line of finite length, all of time can be represented by a straight line of infinite length. This line is, however, formed one portion at a time, in regular succession: therefore, we must either imagine ourselves in motion, traveling along such line; or else imagine ourselves at rest, and the line in motion in one direction continuously. Now, by mentally reversing the direction of the motion of the line, or our motion in traveling along such line, we can mentally bring all portions of it that have already passed, into the field of our consciousness.

But motion means not only something moved, but it means change of position. Now position is determined by matter, an abstract of actual existence; so that any line used in representing time, must bear a distinct relation to matter. It must possess dimensions, although but in one direction.

Time can best be represented in our consciousness by such a line; and as this line bears distinct relations to actual time, the conclusions reached by representing time by such a line, should be true in regard to actual time.

Space is of infinite directions. Time is of but one direction. To determine position in space, three coördinates are necessary. Space is then a system of third degree. To determine location in time, but one is necessary. This one is the present. Time is then a system of first degree. Time being represented by a straight line, some particular point in this line marks the present.

This line being represented in motion, moving continuously in one direction, those portions of the line which have at some time been marked by the point called the present, we designate the past. Those portions of the line which will sometime be marked by the point called the present, we designate the future. There is a difference in the past and future; this difference is a difference of succession. In this line no part can be substituted for any other part. In other words, this line is not homogeneous. Any por-

tion of the line which first passes the present, we will designate as "before"; and that which succeeds it, we will designate "after." The difference between before and after, is an actual difference in nature, and not a difference due to the nature of thought. It is a difference of relation; but relations between things are just as real as material things themselves. It is therefore not a difference within our own minds. This can be verified easily by reversing some simple process; so that the first part of such process be postponed until after the last part be executed. The impossibility of such a proceeding is at once apparent. For example, iron must be heated before, and not after it is welded; it must be melted before, and not after it is cast; a hole must be drilled before, not after a pin can be passed through it; etc. This difference then is only relational, but it is actual and real.

As all time must be filled by events, all time that has passed has been filled by events, or occurrences. If there could have been a beginning of events, then there must have been a beginning of time. Events, however, being always a motion of some kind, a beginning of time or events would be a beginning of motion.* But motion and matter being both abstracts of one reality, if there was a beginning to motion, there must have been a beginning to matter also; and consequently a beginning to space. Space and time are intimately related to each other: for instance, "Space is the possibility of motion"; "Time is the measure of motion." They are both thus intimately connected with motion; but motion can exist only as something moved; therefore, they are both intimately related to matter, to that feature of existence of which dimensions or space is a property. In fact no feature of existence can have had a beginning, unless all of existence had a beginning. The features of existence are so intimately related and connected, so work hand in hand as it were, that they are in fact a unity; so that what has been true of any one feature in this respect, must have been true of all; and all features of existence must partake of the same destiny. Annihilation for any one feature of existence, must mean annihilation for all.

If there was no beginning to time, and if there can be no end

* Causation has been shown by Dr. Carus to be always a motion. (See chapter on "The Problem of Causality," *Fundamental Problems*, page 79.) Therefore if motion or time had a beginning, causation also had a beginning. The first motion was the First Cause, and all others followed. Behind this must lie a reason for the first motion or the first cause.

to time, then it is truly infinite, and without end in either direction from the present.

If this be true, and the world stands at the point of the line called the present, then there is an infinite past in one direction, and an infinite future in the other; two infinities of the same thing, each without end or limit, yet they do not interfere with each other. Neither in any way limits the other, so as to prevent its being infinite. The thought has occurred that possibly the distant future overlaps the distant past, as it were, in some manner; and that the future and the past are one in some way. This can be imagined only by thinking them as being something like a circle. However, the actual and real difference between before and after makes this impossible.

Although both past and future are of infinite duration, and neither limits the other in any manner that prevents its being infinite; yet if we look at this question from another standpoint, the future limits the past at the point called the present, and vice versa. The present is a finite terminus of both; it is a limit beyond which neither can pass without passing into the other. If we mentally remove this terminus, then both future and past are one infinity.

However, if time as a whole is infinite, both future and past are infinite. If we halve infinity, infinity still remains. It can also be said that if we divide infinity by one hundred, or by one million, or by any number no matter how great, the quotient obtained will still be infinity. This means, practically, that no matter into how many parts any infinite feature of existence be divided, each part will still be infinite; or, in other words, as great as the whole was before it was divided. This means, also, that the sum of any number of infinities would be only infinity. The parts are individually as great as the whole, and the whole is no greater than any of its parts. Then nothing is gained, or no increase made, by adding one infinity to another. Neither is any decrease made by any division of infinity or subtraction from it. Then, no matter to what extent the division into parts be carried, we never can arrive at a finite part. If this be true and infinity can not be divided into finite parts, how can finite parts however great their number, make up infinity? No addition of finite parts can make infinity; for infinity is not a number, correctly speaking; it is something else. We must say, with Dr. Carus, that infinity is not an accomplished process; neither is it a thing, an objective something; but merely a process that never can be finished, just as the fraction $\frac{1}{3}$ can never be expressed

as a decimal. "It is a process that from its nature is incapable of being finished."*

Then, to divide infinity into finite parts, we would have to divide it into more parts than any number; which could only be an infinite number of parts. We should have to divide infinity by infinity; but as this is a process that can never be finished, we can not mentally make such a division. However, it would seem that nature has actually made such a division of the infinite past into finite parts; that nature in this case has actually accomplished, or finished an infinite process. For if the portion of time antedating the present is infinite, it has certainly been accomplished. Each finite event that has made up or filled past time, must have existed finitely when it occurred.

Now here occurs one great difficulty. If past time has been infinite, how did events ever arrive at the present? To have done so infinite time must have actually passed. The present is a terminus,—a finite end; and if we reverse the process and mentally move backward from the present towards the remote past, it should be possible to arrive, mentally, at each event that has filled or made up time throughout this infinite past. Now, as each succeeding event at which we arrive must have preceded the one just passed, it is evident that all portions of past time, whether time be infinite or not, must have been present at some stage of existence. The events which make up all portions of past time must have actually occurred, must have been real, and must have existed finitely, and one at a time. It seems evident to me that if by moving in this direction, no limit can ever be reached; and if we can never arrive at a point where these events began, when in reality time was moving in the direction it really is, or in other words was accomplishing the past, the limit called the present never could have been reached. If nature could accomplish or complete this process, moving in one direction, we ought to be able to complete the process of mentally journeying over it, in the reverse direction. In other words, past time is just as long whichever way we mentally journey over it. If no limit can be reached by moving in one direction, then it seems no limit could be reached by nature itself moving in the other direction. If, no matter how far backward along this line we mentally journey, we never can arrive at a point where time began or commenced,—if, in other words, it never commenced; then how, in reality can anything, or rather, any feature of existence, finish

* *Fundamental Problems*, Pages 159, 161, and 169.

a journey it never started or commenced? More correctly speaking, how could time or events finish a process which never was commenced? But, however, as a limit has been reached in one direction, it suggests the idea, at least, that a limit might be reached in the other. In fact, it seems that the present, or rather the point of time marked by the present, could have been arrived at, only by events that make up time having a beginning. Can it be that existence, as we know it, is not eternal?

Of course, if we do move along the line, backwards, towards the past; no matter how far we continue the mental process, when we mentally reverse the motion, we can return to the point of starting, which is the present. A mental process which we can accomplish in one direction, we can of course accomplish in the reverse direction. But if time is infinite, no matter how far from the present we had mentally moved, and no matter how far from the present the point reached was located, yet infinite extension lay beyond that point. The extension still lying beyond that point was just as great as it was before we had mentally moved to that point. We had reduced the distance none. And no matter how far this process had been continued no terminus could have been reached. Now if time is infinite, we never can reach mentally, such a terminus; because it is an unending distance. There is no such terminus to reach. How could nature have accomplished or completed a process, in moving in one direction, which it never could complete, if moving in the reverse direction? How can nature have actually passed over an unending distance, or rather, have completed an unending process?

If nature could reverse its direction, and move backward over past time, the journey should be just the same as nature is to make in moving over future time. If a terminus could be reached in the one case, a terminus probably can be reached in the other. But if nature could not reach such a terminus moving backward, I can not see how, in reality, it ever accomplished the process moving in the reverse direction as it did, and arriving at the present. This would seem to indicate that the process of the past definitely commenced or had a beginning.

The future may be regarded as a process in which there is the possibility of unlimited duration. But the past is a process that has been accomplished. It is definite and has occurred. It is a fact and has been actual. No portion of it is a mere possibility, but all portions of it have actually been realized. No matter how remote

any event that made up past time may be, yet it was just as certainly accomplished as any more recent event. Were this not true, and had time halted and not completed any event in the chain of the past, the present would not be here. The mere remoteness then of any event whatever, in no way detracts from its reality, or its actual existence.

Reckoning from the present, whatever the distance may be down the line of the past, whether infinite or finite, the process of the past up to the point marked by the present is certainly an accomplished process. Now as infinity means, simply, a process that never can be completed, then it would seem that the past can not be infinite. We have, then, in dividing the past from the future, divided time into two parts, one of which seems not to be infinite. Now, if infinity can not be divided into finite parts, by dividing it by a finite number, would not the above result indicate that time as a whole is possibly not infinite?

There can be no time without motion, and no motion without matter as before shown. Now if matter had a beginning, time also must have commenced with matter and motion.

As a fact, it seems there is little doubt that ponderable matter had a beginning. The ether may not have had, as it seems to exist without form; but the ultimate particles of the elements have form, and are evidently what they are simply on account of the form they possess. Now every thing that has form must have been formed, by some formative factor. This would mean that the atoms of the elements were formed,—had a beginning.

Let us take the atoms of any one element. They are so absolutely alike that any one could be substituted for any other, and there would be no change. This substitution, so far as we know, could in no way be detected. The number of the atoms of any one element in the universe may be regarded as being so vast that to our minds it would seem infinite. Yet all this vast number of atoms are absolute duplicates of each other.

If all these atoms never had been formed but had existed always without a beginning, what are the mathematical chances of any two of them being alike, to say nothing of all of them being alike? As practically an infinite number of forms could exist, each atom would have one chance of existing in each one of an infinite number of forms. This means that each atom would only have one chance in infinity of existing in any one particular form. There would thus be only one chance in infinity for any two atoms to be

formed exactly alike, much less the almost infinite number of each element that are absolutely alike.

This likeness between the atoms can not be by chance or accident; it can be only by there being a reason for it. This reason must be that the same formative factors produced all the atoms of the same element. Likeness means relation; and relation in this use of the word, means a common origin or parentage, as it were.

If the new electronic theory of matter be correct, then the probabilities are that each atom consists of a group of electrons, held together in a certain form; that the electron with its surrounding field of force, is the primordial unit of matter from which the elements were formed. But if this be true—and we have here penetrated to the region where it seems force and matter are one—yet each electron is of absolutely the same form as are all the other electrons that make up force, or rather, energy, and matter. The likeness of all in their case can be explained only on the ground that they were formed; that they had a beginning.

Any concrete thing, or any portion of existence possessing form, must have had a beginning; and it must also pass away. The existence by which any concrete thing is actualized is permanent, but the formal feature is subject to the law of eternal change. It is the formal feature of things that appears and disappears. The appearing of form is always caused; and when any number of things have the same form, they have originated from the same cause. All things possessing form must have originated. They must have commenced, as such concrete things, at a definite time.

Should force and matter be derived in some way from the formless ether, by its taking on or assuming form, or by form being impressed upon it in some way, I think this would not necessarily mean a beginning to time. The ether is able to transmit motion and, it would seem, bears some relation to motion. It must therefore bear some relation to time.

Time is abstracted from motion, but time and motion are not identical. It is true that there can be no motion without time, and no time without motion, as we know them. There is a relation between these features of existence but they can not be identical. The momentum of a moving body varies directly as the weight or mass of the body moving; but it also varies as the square of the velocity. This would indicate that velocity is the greatest factor in the momentum of a moving body. But velocity is made up of two elements, the time element and the space element. The time

element of motion is thus shown to be very real; and is as independent of motion, as motion is of time. Yet the relation between the two is so intimate that the non-existence of one means the non-existence of the other.

Either time had a beginning, or it had not. No third possibility can be imagined. Time is merely one feature of the All-existence. To say that time had a beginning or that it had not, simply means that events had a beginning or that they had not. Either events did commence, or there has already passed an unending chain of them.

To say that events had a beginning, is making a statement utterly beyond the power of the mind to realize in consciousness. The first thought that occurs when making such a statement, is that there was a time when events commenced. This supposes time already existing when events began, which is an absurdity; as there can be no time where events are not.

It is also beyond the power of consciousness to realize the statement that events are part of an infinite series, that never commenced, but always was; for each event was a transitory occurrence. None of them could be permanent, therefore, any series of them would seem to possess this transitory character. Such series would seem not to be permanent, or rather eternal. Each finite event that makes up the series of the past, must have existed, must have been real, and must have required duration to exist. Each by itself must have commenced, endured, and terminated. Then if *all* the events of this series commenced, did not the series also commence? If there can be *no* event of this series that did not commence, how can we escape the idea that the series commenced? Evidently we can only escape this idea, by imagining more events in this series than the word *all* can express.

However, no matter what the difficulties are, the present is here. Now, in fact, all portions of past time were the present as they passed; and the present has not been reached, but was always here and moved along with time. Dr. Carus, quoting from Schopenhauer, says, that there are not three times, past, present, and future: there is but one time, which is the present, and it is always. This is true from the point of view where the whole of eternity is viewed as one. However, events occur in a succession. Certain events precede others. There is a difference in nature between before and after. This difference is actual and has an objective existence. Were this not so, as before shown, processes could be reversed.

When we speak of past time, we mean the feature of duration abstracted from events that have actually occurred. By the future, we mean the feature of duration abstracted from events that are to occur. Events that are to occur are just as real, just as actual a part of existence, as events are that have already occurred.

When we speak of the present, we ordinarily mean that portion of duration in which events are in process of occurring. However, if we analyze our conception of the present for a moment, we must conclude that the present has no duration; it is not a portion of time correctly speaking. If it were a portion of time, we should be able to determine how long a period of time constitutes the present; whether a minute, a second or a fraction of a second. We should have to place a limit somewhere, which would be wholly arbitrary; and if we gave it any finite length or duration, certain portions of it would be already passed, and certain portions of it would lie in the future.

As the present has been always, we must represent it as moving along over all portions of time; as a point without dimensions, marking position or location only.

Then that which we call the present, can in reality have no more dimensions than a geometrical point has; and if we say that the present has no dimensions, which means that it has no duration, it is not, properly speaking, a portion of time. Time has duration; and any portion of time must have some duration. If the present has no duration, merely marks position as it were, it merely divides the past from the future; it divides the events that have occurred from the events that are to occur. Each event, as it occurs, passes from the portion of the imaginary line where are the events that are to occur, to the portion of the line where are the events that have occurred. A line has dimensions in one direction only; time has duration in one direction only. A point merely marks position in a line; the present merely marks the dividing position between the past and the future.

Whether time had a beginning, or whether it had not, we can not decide positively; but we can decide that which seems to our minds most probable. I have sometimes been inclined to the belief that events as we know them had a beginning. That existence, as known to us, with its features of time, space, matter, energy, spirit or subjectivity, the formal and the relational, had a beginning. That it possibly originated from a form of existence utterly unknown to us; a form of existence where the word "form" hardly applies,

as there could have been no formal then; an existence where matter, energy, time, space, and all features of existence as we know them are not. An existence where the word "existence" must be used for want of a better word, but that which is meant is something other than existence as we know it.

If existence had a beginning, we must think of it in this manner; for we can not imagine that it could arise from nothing. Of course, if a beginning did occur, an end can also come to existence as we know it. Then time and space will cease to be, and so will all things that are actual and real.

However, in spite of the difficulties herein mentioned, it seems to me, most probable that time is truly infinite or eternal, and did not have a beginning; that if it did have a beginning which means that existence had a beginning also, in order to comprehend this statement we should have to be able to mentally annihilate all existence, which would include our faculty of reason; and we could therefore in no way reach such a conclusion.

II.

As before stated, space is abstracted from the material element of existence. We mentally think away all of the qualities of existence, except that of extension. That which is left we term space. It does not exist in reality separate from other existence. It is merely that property of existence by which it extends. Space is filled with existence as we know it. Matter together with the ether fills all space. We can find no space empty of both.

Space then seems to contain all existence, material or otherwise; including time or duration, events, as well as the formal and the relational, together with all the laws of existence. But, as Dr. Carus says, we must not think of space as an empty box containing existence, as a thing-in-itself. It is merely the property of extension which existence possesses. He also says it is the possibility of unlimited motion in all directions.

If time is merely the measure of motion, space must likewise be the measure of matter; and as space is a mental abstract from the material feature of existence, there can be no space, except as there is existence filling it. Space means dimensions. There can be no dimensions, except dimensions of something—of actual existence. A nothing could have no dimensions, neither could it have any other attributes, features, or qualities. It therefore could not exist, or if it could it in no way could be known to us. In fact, if it existed, it

would be a something. There can be no region outside of space, no border line beyond which lies nothing. Nothing could in no way bound space, or existence. To do so, dimensions would be required. As a nothing can have no dimensions, space—or, more correctly speaking, existence,—can not be bounded by a nothing.

Most words have meanings because they represent an objective reality. The word "nothing" stands for no objective reality or existence. It is a word to express the non-existence of things that are. Now the non-existence of any thing that is, is an impossibility, an absurdity.

When we speak of nothing, we ordinarily mean space with all matter extracted or removed therefrom. Now this is an impossibility; but were it possible to entirely remove ponderable matter from such a vacuum, the ether would still remain. Also, were it possible to produce a vacuum in which there was neither matter nor the ether, we should still have space or dimensions remaining; neither could we remove from such a vacuum, time, the laws of mathematics, the action of gravitation, or any of nature's laws. All of these are parts of existence, and are as actual and as real as are the other features of existence. They are not material, it is true, but they are just as real as matter. Time and space are something and not nothing. If time and space were nothing, we should, as Spencer says, have two different kinds of nothing, which is an absurdity. The ether also is as much an actual existence, as is that feature of existence which possesses mass, gravitation and inertia, and that can be affected by friction.

It may be regarded as proved that the ether exists everywhere; not only in the spaces between the stars, but also penetrating the actual atoms of matter. That is, the ether and material atoms actually occupy the same space at the same time. It is as if the ether were something like a condition, rather than like an actual material as comprehended by our consciousness. Matter can move through the ether and meet with no resistance; because there is no contest for space or position, as it were, between ether and gravitational matter, both being able to occupy the same space at the same time.

Now the ether is everywhere; and as before stated, it can by no possible means be removed from any portion of space, any more than time, dimensions, or the action of gravitation can be removed from space. No vacuum can be made void of the ether; but if such a thing were possible, we should not have a true nothing, for space is something. A true nothing must be void of space as well as of

the ether, and therefore can not have dimensions; for if it did have dimensions it would be a something. If we could remove the ether from a portion of space, so as to form a void, this void would be bounded by walls of ether; but if this void were nothing, having no dimensions, the walls of the ether would still be in contact, which is an absurdity. It is plain that dimensions, being an attribute of or abstract from that which actually exists, can not therefore be possessed by nothing; and as nothing can not have dimensions or any other feature of existence, it must be a non-existence, a creature of the fancy, an absurdity, an imaginary annihilation of that which is.

Further, if a nothing can possess no dimensions, it can in no way limit actual existence. An infinite number of nothings, if they existed in the ether everywhere, could not make themselves known; and requiring no room, the ether would not be displaced, but would contact itself at all points. Neither could a nothing in any other way be known or detected by any form of existence, as it could possess no qualities, attributes or features.

As before stated, there can thus be no region out in space beyond the cosmos, where there is nothing; for a nothing having no dimensions can not bound a cosmos having dimensions. It could in no way limit existence or in any way displace anything that is. If the cosmos is infinite, having no limits it can not be limited by a nothing; while if it were finite, it would possess finite dimensions, and could not be bounded or limited by a nothing having no dimensions. Therefore everywhere there is something. That is, the All is infinite and without end in space, and would seem to be eternal, or without end in time. In fact, both time and space are parts of the All, or different modes of manifestation of the All to our senses.

Then, there can be no end to space, or more correctly speaking to existence, in any of the infinite directions of space. If we could travel in any direction, at any speed however great, no matter how long we might continue such a journey, we should never arrive at a limit or boundary. It would then seem that non-existence is an impossibility. Existence is positive, is actual, and in no way can it change into non-existence. Such a change would be an absurdity. We came out of the All at birth, and return into it at death. The All is infinite in both space and time, and possibly, "in diversity in the same space at the same time."

Things that are, neither came out of nothing nor can they return into nothing. Every thing that is, was built or formed out of what previously existed; this means spirit as well as matter, soul as well

as body. The fact of the existence of a thing proves at least the permanence of that of which it is formed or constructed; and thus are we ever more firmly convinced of the permanence of that which is.

III.

Why this mystery? How came it so? The world-old problems are still with us. How came we here? Why do we exist? What is our destiny?

We awaken into existence to find ourselves on a monster globe rushing through space at inconceivable speed, in a well-defined path or orbit. We also learn that the world and its orbit, together with all the sister planets and the parent sun, are falling into the unknown depths at a terrific velocity; that this fall has been going on since the world began. We are descending towards a point near the giant sun, Vega. Our actual path is a huge spiral.

Never, since the world began, has there been one moment of quiet or rest; but we have been continually falling into the "deep that is infinite," into the "ocean that is without bottom and without shore." While we continue this terrific journey into the unknown abyss, the mighty River of Time is rushing along, bearing us, the world and all we know, like ephemeral creatures on the crest of a wave called the present, to a destiny no man can foresee. Yet, all things seem to have a purpose in fulfilling their destiny. Let us hope that our existence, also, is not without a purpose.

The old questions, How came this mystery? How came we here? Why do we exist? What is our destiny? must ever press for solution as long as man has a mind to think with, and a desire to live. As long as man shudders at the thought of annihilation of self, will he struggle to solve these problems.

Science, in attempting to answer the question, How came we here together with this world? has become involved in innumerable controversies with religion. Yet the difference between them, if viewed impartially, is only a difference of detail. They are both agreed that we and the world were not always here. Consequently, we must have appeared out of the void at some definite time. That we did not come by any power of our own, both are agreed. Therefore, we were produced by a power other than ourselves. That same power will take us away again, and that power holds our destiny in the hollow of its hand.

Whether that power is, as religion has taught, a concrete personal being, that has fashioned this world, our bodies and our souls

as well, outside of itself, as separate existences from itself; or whether, as science is teaching, that power is not a concrete being but is a power immanent within all concrete things and beings, is uncreate and uncreatable, is without form but perfectly real; yet, we must all admit that this power, whatever it is, was perfectly capable of producing us and the world.

The method pursued makes little difference to us; the results are the same. We are here. This power has created us. What our destiny is to be, human eyes can not yet see. We can only hope. Science gives us a faith. We were not made of nothing. "That which is now us, was before, and will be after us." "The All-existence will not lose an iota at our death."

Positive existence can not be changed into nothing. It must be changed into something else. The change is merely transformation. Our beginning was transformation, so will be our end. Death then is transformation. This means, for both body and soul.

"There is one reality. Viewed from different standpoints it presents different aspects to us." "Viewed from the outside, the aspect is material. It is matter in motion." From the outside our beings have this aspect: "They appear as an object in the objective world, moving about." But, viewed from the other side, from the inside, the aspect is that of spirit. Here we find only thought and feeling. Joseph Le Conte says, when we look within ourselves, we experience by introspection, only thought and feeling. That this is the only place in nature where we do get behind matter, and here we find only spirit.

These are the two sides of reality, but, as Dr. Carus says, we must remember that they are both merely aspects of one reality viewed from different standpoints. "The spiritual side of man, that is the subjective side, his thinking and feeling, his innerness, is just as real as is his material, or objective side." Both belong to one reality; they arise together and go hand in hand. At death they partake of the same destiny. Neither can be destroyed; only transformation can take place.

The formal element of all existence is subject to continual change. No form or structure can be permanent. It is the structure of ourselves that is changed in death. Death is a transformation of the formal element of existence. Existence of itself is permanent, but its formal element is in a constant flux. Its structures are continually modified and changed. Thus it is that all compounds will be dissolved again. All things that can be changed, will be

changed some time. No concrete thing can be permanent. No structure can endure.

If forms were permanent, no change could ever take place. There could be no motion. There would be no causes, and no effects. Existence would be one vast tomb, where never an event could occur, and where monotony would be so terrible, that immortality would be a curse. In an existence where form is one of its features, it is well that such existence should be a perpetual motion within itself, and that the law of eternal change should prevail.

We must not forget that all structures have their subjective side. Our souls are the subjective side or innerness of special structures, of special forms of existence passing through a series of changes of a special form. The existence out of which both the subjective and objective sides of these special structures are formed, or created, is permanent. All existence has its subjectivity, or innerness within itself. When water is brought into contact with calcium carbide, and the love of the hydrogen atoms is felt for the atoms of carbon, and they rush together and unite, forming a new compound; I believe there is a subjectivity, or innerness within these atoms which directs their action. This subjective side of nature which corresponds to the spiritual in man, is just as real, and just as permanent, as is the objective side, the outside, or material side of existence. Both sides are but different views of one reality, as Dr. Carus has so ably demonstrated.

"Whither do we fare?" The great River of Time will some day bear us to a region where the answer awaits us. But we can rest assured, we are not borne toward that hideous monster, annihilation. Rather let us hope that the transformations which are to come, will not be as a sleep deep and profound, but "as a dream filled with pleasant visions." Yes let us hope; although out of the stillness of the depths no voice ever comes, and our riddle remains unsolved.

"The heavens are our riddle; and the sea,
Forested earth, the grassy rustling plain,
Snows, rains and thunders. Yea, and even we
Before ourselves stand ominous in vain!
The stars still march their way, the sea still rolls,
The forests wave, the plain drinks in the sun,
And we stand silent, naked—with tremulous souls—
Before our unsolved selves—we pray to one
Whose hand should help us. But we hear no voice;
Skies clear and darken; the days pale and pass,

Nor any bids us weep or bids rejoice.
Only the wind sobs in the shriveling grass—
Only the wind—and we with upward eyes
Expectant of the silence of the skies."—*Herbert Bates.*

DAVID P. ABBOTT.

OMAHA, NEB.

ESPERANTO.

Esperanto, a universal language invented by Dr. Zamenhof, a Russian, and advocated mainly in France, has at present outdone Volapük, and enjoys a great popularity among the circles of those who favor the adoption of an auxiliary international language. We had some correspondence on the subject with Monsieur Couturat, and have discussed the problem in former numbers of *The Monist*. Though we do not say that it is impossible to construct an artificial language which would be simpler than any of the natural languages, we believe that it would be easier for mankind to adopt the simplest natural language, and accept it as the international medium. It seems to us that among all the languages of the world, English possesses the greatest chance of becoming a medium of international speech. In fact it is the only language which possesses an international character. English is spoken not only in Europe, but in Canada, United States, Australia, South Africa, and constitutes the natural medium among the different races of India, among the Europeans in China and almost any other country of the globe.

We are not blind to the objections that can be made to the adoption of English as an international language, but we believe that English can most easily be changed into a shortened English, a language built after the pattern of the English, utilizing its simplest constituents, endings, grammar and syntax, and avoiding the difficulties of spelling.

The objections made by the advocates of a purely artificial auxiliary international language are mainly directed against the English nation, claiming that it would be materially benefited by forcing its speech upon other countries. Further there is the *th* which is difficult for the continental European to pronounce; and a few other inconveniences in pronunciation exist, none of which are too strong to be overcome. Whether or not the English will conquer in the long run, or whether Esperanto will gain the victory remains to be

seen. For the benefit of our readers we will here present an impartial exposition of the nature of the language, its endings and prefixes, and its general construction.

LETTERS AND THEIR FORMATION.

Esperanto is built mainly upon the Latin grammar, and its constituents belong pre-eminently to the Romance languages, with a few scattered ingredients from German and English. The vowels are pronounced in the continental way; "a" as in father, "e" as "a" in care, "i" as "ee" in seen, "o" as in quote, "u" as in rule. The diphthong "au" is pronounced as "ow" in cow. Most of the consonants are pronounced the same as in English, especially "b, d, g, k, l, m, n, p, r, s, t, v, and z," but "c" is pronounced like the German "z," i. e., like "ts" in the Russian word Tsar, and "j" is pronounced like "y" in yes. Further there are a few consonants which are differentiated by a double accent (circumflex). This combination will make Esperanto objectionable in many printing establishments because the characters are not now made in our type foundries, and we will here replace the accented letters by italics. This differentiated "c" is pronounced as "ch" in church; the differentiated "g" is pronounced as "g" in gin; the differentiated "j" as the French "j" or as the English "s" in pleasure; the differentiated "s" as "sh" in shall.

We see that Esperanto has also its difficulties in pronunciation as well as Volapük. Ts, the Esperanto "c," is hard to pronounce, and there are many Germans who find difficulty in pronouncing the soft "g" in such words as "German," being unable to distinguish it from *Cherman*. The same is true of the French "j" corresponding to the English sibilant in pleasure.

NOUNS, ADJECTIVES AND ADVERBS.

The ending "o" indicates a noun; the ending "a," an adjective; and "e," an adverb. Thus "patro" is father, "patra" is paternal, and "patre" is paternally. The plural is formed by adding "j," and the objective case, by "n." Thus "patroj" means fathers. "patron" is father in the objective case, and "patrojn," fathers in the objective case.

PRONOUNS.

The pronouns are as follows: "mi," I; "ci," thou; "li," he; "si," she; "gi," it; "ni," we; "vi," you; "ili," they; "si," the reflexive of the third person, himself, herself, or itself, oneself, themselves; "oni"

corresponds to the French *on* or the German *man*. The objective case of the personal pronouns is formed as in nouns by adding "n" to the subjective form, as "min," me, while the possessive is indicated by the adjective ending "a": "mia," mine; "via," yours, etc. and "illiajn patrojn" is an acusative plural meaning their fathers.

NUMERALS.

The cardinal numbers change their forms as little as in other languages. They are:

1 unu	5 kvin	9 nau
2 du	6 ses	10 dek
3 tri	7 sep	100 cent
4 kvar	8 ok	1000 mil

They are combined as in English, for instance 735 is "sepcent tridek kvin."

Ordinals are formed by adding the adjective ending "a": "una," first; "dua," second; "tria," third.

Multiples are formed by the ending "obl"; twofold is "duobla" and tenfold, "dekobla"; fractions by adding the ending "on": one-half is "duono" ("du," root; "on," fraction ending; "o," noun ending) three-fourths is "tri kvaronoj."

By adding "op" before the adverbial ending "e," collective numbers are formed which are introduced in English by the preposition by; for instance, by dozens is expressed as "dekduope" in Esperanto. When he wishes to say "at the rate of" the Esperantist uses the preposition "po," thus "po ses" means, at the rate of six.

Ordinal adverbs, as, firstly, secondly, and thirdly, are formed by adding the adverbial ending "e" to the corresponding cardinal numeral; thus "unue, due, trie," etc.

VERBS.

The endings needed for the verb are much more numerous than in English. The ending "as" stands for the present, "is" the past, and "os" the future. The imperative is expressed by the addition of "u" to the root; the conditional, by "us"; the infinitive, by "i"; thus: "mi skribas" means I write; "mi skribis," I wrote, "mi skribos," I shall write; "skribu," write; "ni skribu," let us write; "mi skribus," I should write; and "skribi," to write.

The participles follow the same rule, viz., that "a" stands for the present, "i" for the past, and "o" for the future. The endings "ant," "int" and "ont" are the active participles and "at," "it" and

"ot" are the passive participles. Thus "skribanta" means writing, "skribinta," having written, and "skribata" being written.

PREFIXES.

The language is further enriched by a number of prefixes and suffixes. The prefixes are as follows:

"mal-" denotes opposite ideas; "rica," rich; "malrica," poor; "fermi," to shut; "malfermi," to open.

"bo-" denotes relation by marriage: "patro," father; "bopatro," father-in-law; "frato," brother; "bofrato," brother-in-law.

"ge-" denotes persons of both sexes, taken together: "mastro," master; "gemastroj," master and mistress; "onklo," uncle; "ge-onkloj," uncle and aunt.

"dis-" denotes separation (as in English): "jeti," to throw; "disjeti," to throw about; "semi," to sow; "dissemi," to disseminate.

"ek-" denotes beginning and momentary action: "brili," to shine; "ekbrili," to flash; "kanti," to sing; "ekkanti," to start singing.

The list of suffixes is considerably longer:

SUFFIXES.

"-in" denotes feminines: "onklo," uncle; "onklino," aunt; "koko," cock; "kokino," hen.

"-et" denotes diminution of degree, etc.: "lago," lake; "lageto," pond; "varma," warm; "varmeta," lukewarm.

"-eg" denotes enlargement, intensity of degree: "domo," a house; "domego," a mansion; "varma," warm; "varmega," hot.

"-an" denotes an inhabitant, member or partisan: "Londono," London; "Londonano," Londoner; "Kristo," Christ; "kristano," a Christian.

"-aj" denotes concrete qualities: "mola," soft; "molajo," soft material; "amika," friendly; "amikajo," a kindness.

"-ec" denotes abstract qualities: "mola," soft; "moleco," softness; "amika," friendly; "amikeco," friendship.

"-id" denotes the young of, the descendant of: "kato," cat; "katido," a kitten; "hundo," dog; "hundo," a puppy.

"-ar" denotes a collection of things: "vorto," a word; "vortaro," a dictionary; "arbo," a tree; "arbaro," a forest.

"-ej" denotes a place where an action occurs: "lerni," to learn; "lernejo," school, "kuiro," to cook; "kuirejo," kitchen.

"-er" denotes one object of a collection: "mono," money; "monero," coin; "sablo," sand; "sablero," grain of sand.

"-estr" denotes a chief or leader: "sipo," ship; "sipestro," captain; "regno," state; "regnestro," ruler.

"-ist" denotes trade, profession or occupation: "drogo," drug; "drogisto," a druggist; "boto," a boot; "botisto," a bootmaker.

"-il" denotes a tool or instrument: "bori," to drill; "borilo," a gimlet; "razi," to shave; "razilo," a razor.

"-ing" denotes holder into which one object is put: "plumo," pen; "plumingo," penholder; "kandelo," candle; "kandelingo," candlestick.

"-uj" denotes container of material or a collection: "inko," ink; "inkujo," inkstand; "mono," money; "monujo," purse.

"-ul" denotes one remarkable for some quality; "brava," brave; "bravulo," a brave man; "bela," beautiful; "belulino," a beauty (feminine).

"-em" denotes propensity or disposition: "babili," to chatter; "babilema," loquacious; "kredi," to believe; "kredema," credulous.

"-ebl" denotes possibility (Engl. -able, -ible): "vidi," to see; "videbla," visible; "kredi," to believe; "kredebla," credible.

"-ind" denotes worthiness: "admiri," to admire; "admirinda," worthy of admiration, "memori," remember; "memorinda," memorable.

"-ad" denotes duration and continuation of action; "pafo," a shot; "pafado," shooting; "rigardi," to look at; "rigardadi," to view.

"-ig" denotes causing something to be: "morta," dead; "mortigi," to kill; "bruli," to burn; "bruligi," to set on fire.

"-ig" denotes the action of becoming: "ruga," red; "rugigi," to blush; "fluida," fluid; "fluidigi," to become fluid.

"-edz" denotes a married person: "doktoro," doctor; "doktoredzino," doctor's wife; "fratino," sister; "fratinedzo," sister's husband.

"-cj" denotes masculine affectionate diminutives: "Josefo," Joseph; "Jocjo," Joe.

"-nj" denotes feminine affectionate diminutives: "Florenco," Florence; "Flonjo," Flo.

"-um," indefinite suffix playing similar role in forming words as "je" amongst the prepositions: "plena," full; "plenumi," to fulfil; "vento," wind; "ventumilo," fan; "kruco," cross; "krucumi," crucify

* * *

Dr. Zamenhof constructed the new language while he was attending school in the eighth class of the Gymnasium in 1878, and

he celebrates the fifth of December as the birthday of Esperanto. It is natural for a man of his type to be also poetical, and he celebrated his invention with a hymn, "La Espero in Esperanto," which is the favorite song of Esperantists.

It begins with the following stanza:

"En la mondon venis nova sento,
Tra la mondo iras forta voko;
Perflugiloj de facil vento
Nun de loko flugu ĝi al loko."

These lines are literally translated as follows:

"Into the world has come a new sentiment,
Through the world is going a mighty call;
On wings of light wind
Now from place let it fly to place."

One of the most active advocates of Esperanto is Mr. Richard H. Geoghegan, of Seattle, Washington, a scholar of great versatility, who is not only familiar with European languages, including the Russian, but also with the Chinese and some languages of the American Indians.

He has written a grammar of Esperanto, and I do not hesitate to look upon his recommendation as valuable.

He writes as follows:

"I have used the language since 1887 in correspondence on linguistic matters and otherwise, with over 300 correspondents in all parts of the world, and have found it a true creation of genius. The more I use it the more I admire it. I have received hundreds and hundreds of suggestions for "improvements" during the past 15 years, but have yet to meet with a single one that, on practical experiment, is worthy of adoption. I have also used the language in conversation with a European gentleman, whose native tongue I do not speak,—nor he mine,—and during an entire day's social intercourse we had not the slightest difficulty in understanding one another. It is a marvelous adaptation of the existing truly international word material. Mi opinas ke Vi ankaŭ ne povas ne sat: kaj disvastigi ĝin?"

The first Esperanto Gazette was published by Mr. H. Bolingbroke Mudie.

The British Esperanto Association has its headquarters at 13 Arundel Street, Strand, London, W. C., and its official journal is *The British Esperantist*.

EDITOR.

ON THE NOTION OF GOD AND THE PRINCIPLE OF RELATIVITY.*

I do not propose to take up again, after so many famous writers, the development, or criticism of the notion of God. Still, we generally find this idea coupled with a logical and psychological question about which I wish to present a few remarks.

It seems indeed as though the traditional evidence concerning the notion of a personal God, ruling over the external world, had lost favor with philosophers, if not with theologians. The reason for this is easy to state. Whether this evidence is called cosmological or ontological; whether it is founded on analogy or the necessity of universal concepts; on contingency of things or inequality of natures; whether it appeals to the idea of being or the idea of good, of moral perfection; to the principle of contradiction or to the principle of causality, one and the same psychological situation is found under all the discussion. In such a debate we only give expression to what is already present in our thought; we oppose the positive term of a series to its corresponding negative term, and give actual existence to relations conceived in our minds.

It is a fact of common experience that the knowledge we have of ourselves implies a change in our states of consciousness. It is the same with the perception of self as of the motion of an external object: we perceive and determine motion only by the changes of position of the object with relation to bodies at rest or of a different velocity. That is why our concepts always imply the idea of a "relation" and are framed in what may be called contradictions.

We know that there are several kinds of these contradictions which do not always exactly correspond. Affirmation and negation, existence and non-existence, for instance, are not to be compared in every particular with other contrasts, such as absolute and contingent, infinite and finite, unity and multiplicity. The former concern existence which may be only affirmed or denied; the latter concern modes of existence, which are rendered comprehensible by their very opposition and do not at all exclude each other in the way in which non-existence excludes existence, or negation, affirmation. But they always practically imply a relation between opposite terms, whether these terms express pure concepts, either logical or numerical, or states of feeling, or moral ideas, as in the case of con-

* Translated from the French by Amélie Sérafon.

trasts of a different order, such as pleasure and pain, desire and aversion, good and evil.

These contrasts, these antitheses indicate mere attitudes of mind; they represent our way of feeling and understanding; they are the forms of our affective and mental life, the conditions by means of which we become conscious of our relations with the external world, and connect the moments of our own personality. In this sense it is clear that everything is relative, that neither we ourselves exist, nor anything exists for us except by comparison with other existences. Thus the operations of our intelligence can be reduced to a faculty of forming series, the supposed last terms of which are to us a kind of concept-limit, not representable in themselves, and made intelligible only by the relations they symbolize.

As soon as we externalize these conditions of consciousness and sensibility, we create artificial contradictions. In fact, we cannot eradicate from our conception of things the imprint of our own mind, nor doubt the realities to which our own logic adapts itself. Neither can we, except by means of hypothesis, liken the capacity of our mind to the capacity of the universe, and we can only imagine, without ever attaining, a condition in which the consciousness of the subject might be the complete and perfect expression of the object.

Herein we find the defect of any kind of evidence that relates to metaphysics. To those who will admit no other source of knowledge than experience, theologians raise the objection that reason is a no less valuable source of knowledge. Still, reason is controlled by experience, and is entirely dependent on conditions of experience. We might even say, and it has been said before, that all knowledge is but sensation transformed or reflected.

Limited as it is by the law of relativity, our reason could never know God except in the form of a relation, which according to the expression of a neo-criticist, might be called "*relation par excellence*"; there is also the old argument of the schools, that it is not lawful to pass from the concept of existence to absolute, real existence. No doubt, great thinkers like St. Anselm, Thomas Aquinas, and Descartes, recognized the difficulties of such a subject. They found that a too close investigation of grounds of belief would have resulted in pantheism, that is to say, in the notion of God in nature and ruling it from within. For all this evidence implied after all the oneness of God and the world, since it seemed irrational to designate degrees or distinctions in the absolute.

Renouvier, who claimed to be a disciple of Descartes and Kant, undertook the task of opposing modern doctrines, whether naively dogmatic or thoroughly skeptical, and which, according to him, result either in a vague pantheism or discreet atheism, and according to which the individual and personality are nothing in the world but transitory phenomena, and the universe the outcome of a substance unknown to itself, and manifested in the infinity of time and space. God and the soul (which to him were one and the same idea) remained the center of his own particular doctrine. But in order to prove their existence and demonstrate the thesis of a providential or natural finality, he was obliged first to refute the realistic doctrine of the absolute substance, of that infinite "thing" without beginning or end, the development of which might be the universe; hence, to refute the doctrine of universal determinism. The principle of contradiction in which he takes refuge, would preclude attributing reality to any object which might be conceived as a composite of modes, qualities, parts, or distinct moments, of infinite and interminable number though actually acquired and imparted in all its unities. Moreover it would prevent accepting the essential predetermination of the future, for otherwise it would have to be admitted that every phenomenon occurring at present is the predestined result of an infinite number of former phenomena. This would be contradictory.

It is one thing to consider in our practical operations a first and last state, and it is another thing to conceive in the abstract a beginning and an end of things. We are at liberty to imagine the formation and destruction of a globe like our earth, because in this case we have a question of a succession of events which are real, determinable, divided for the sake of convenience in speech into the indefinite succession of cosmic accidents. But we may not speak of a beginning and an end in the absolute sense, and our thought itself refuses to admit a complete and sudden creation, a world extracted from nothingness. The words "beginning" and "end" are nothing more than symbols in this case. They represent an opposition the terms of which could not effectively limit the illimitable series of possible events. To any given magnitude you may always add another magnitude, and this is the only really clear expression of the primary fact of consciousness, under the pen of the philosopher as well as of the geometrician.

In short, Renouvier's idealism also evades the laws of reason. Moreover, he acknowledges that he is compelled, for want of evi-

dence, to consider God and liberty as objects of "rational belief." And his belief finds secret, may be unperceived, motives in the classical arguments of the naive realism which he congratulated himself upon having cast aside. This shows that we all remain in spite of ourselves, both idealists and realists at the same time!

An article published in *The Monist* (Oct. 1905), over the signature of Henry Bedinger Mitchell, presents this serious subject in a new light. Mr. Mitchell first attempts to evade the difficulty of conceiving as a whole, as a unity, that which by definition is infinite. The oneness of an assemblage depends chiefly on the law which connects its elements, namely, on psychological action; and such would be the modern definition of the finite and infinite founded on this consideration—putting aside details—that it would justify us in affirming the characteristic of infinity in man and in passing from mathematical infinity to that of the theologians.

Still this first step is difficult to take. It seems indeed that the faculty we have of forming series, should remain the primary fact and that the new definition justifying our hold on the "infinite" were forever begging the question.

Mr. Mitchell does not dispute this fact. He admits that "intellectual" consciousness is relative and that our mind acts necessarily in multiplicity. Accordingly he attempts a bolder step. He makes a rather subtle distinction between assemblage meaning multiplicity and assemblage meaning unity: cognition of the first according to him belongs to the mind, of the second, to the "heart."

This is the process, he tells us, which is used by mystics and artists. But then, with what kind of reality have we to deal? Mr. Mitchell now undertakes to make these two methods, of reason and of the heart, conform to each other. This is the third point of his thesis.

The method of comparison, he writes, is reputed the only scientific one. It is considered an act of intelligence, the method of direct perception being reckoned an arbitrary act of imagination. However great the action of reasoning may be in the comparison preceding any kind of generalization, the conception of a general law is not the result of pure reason. It is a creative act, comprising selection, desire and volition, but never logical compulsion. Through this act, something new passes from the *potential* world into the *actual*. Amongst the infinitely numerous explanations required by a series of phenomena, we choose the corresponding type between these phenomena and our concepts. And it is not this liberty of

selection which causes the instability of the explanatory hypothesis, but the inherent weakness of the scientific method. We can only substitute a unity which is known to ourselves, because created by ourselves, for an unknown but *intuitively felt* unity. If facts lead us to it, the "heart" helps along; it does not deceive us any more than our senses do.

Is it not exactly this point, I would ask Mr. Mitchell, which gives value in the first place to the hypothesis in science? It necessarily participates in our researches. Science always starts from some conjecture, and then branches off with other conjectures into philosophy. The important question is to estimate what the conjecture or hypothesis is worth, and consequently shall we not be led to admit that its quality depends on the facts on which it is based, on the more or less broad and solid foundation on which it rests?

This discussion which started with the relativity of knowledge, is finally centered in the difficult problem, the range of sentiment. And now, if I am not mistaken, we are led back, as far as the notion of God is concerned, to what may be called the "naïve" way of thinking in which, after all, the believer holds his ground most firmly, and from whence I have not the slightest intention of driving him.

There remains for us still (to reverse a famous adage) to decide whether sentiment is truly a *prima cognitio*, and whether there is anything in the heart of man to-day, save the predominance of passions, which has not first originated in his head. However, I am far from rejecting in all cases the significance of sentiment, or the consequences which may be deduced therefrom. I appreciate Mr. Mitchell's clever argumentation in spite of the slight reservations which I have felt it my duty to make, but I acknowledge that I wonder at the attitude of those who, imagining that they possess an intuitive idea of the absolute, of the infinite, yet say that they feel humiliated at not being able either to represent or understand it. Furthermore I can not believe that our inmost self should have the privilege of feeling this absoluteness, the phantom of which our intelligence tries in vain to grasp. Neither can I make up my mind to give words to a meaning mysterious to me, nor do I expect so high a metaphysical revelation for a mere psychological state.

Far from renouncing the notion of God, I, on the contrary, agree with Dr. Paul Carus in affirming that it stands for too great an effort of the human mind, as well as symbolizing truths which

are too important for the conduct of life, for us to be so rash as to abolish it.

I only wished to show in these few pages the flaw in certain demonstrations, and if I were called upon to give a concise formula, expressing my exact thought, I would say that God is the *logical expression* of the universe—"the moral law of nature," writes Dr. Carus, and let us not aspire to greater enlightenment.

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HUME VERSUS KANT.

To the Editor of The Monist.

In comment on some expositions in your *Primer of Philosophy* I wish to contribute the following observations on Kant's relation to Hume.

In answer to the question "Is Hume a skeptic?" I would decidedly say: No!

In order to justify my position it may be well to define the word skepticism.

Skepticism is the result of the dogmatical use of reason, without careful criticism (Kant).

Skepticism is that view according to which man can have only uncertain opinions, but no exact knowledge (Hume).

Skepticism is the result of reason throwing its light upon itself, thereby unweaving at night what it wove in the day, analogous to Penelope's texture (Rev. Rickaby). This last definition speaks for itself.

Radical skepticism flatly denies the fact that we can have a criterion of truth, yet the fundamental problem of all knowledge is this: Can we have such criteria? Indeed, if by constant truth is understood a judgment which has been for all time and will for ever remain recognized as valid, there is no truth. For every constant truth which has been heralded as such since the dawn of thought, has found many to deny it with abundant proof. But if there is no unconditional truth, we must assume as truth that which appears as such at this very moment, since the next moment may disprove it.

On the other hand, if we deny the objective measure of value

(criterion) of truth, science is no more. In its stead there will be nothing but opinion, no more definite direction of will, but arbitrariness (Willkühr) and fitful humor.

This fitly leads us to consider the relativity of knowledge. Where the radical and dogmatic skeptic is at error, is in his profession to have strictly proved his conclusions, and to hold it positively as a valid inference. Now this conclusion is either proved or not. If it is not proved, he has failed in his main object; if it is proved, then the many facts and principles which went to build up the proof, are thereby declared invalid; for they imply a large mass of human certitudes. His premises appeal to observed facts, which, however, he declares suspicious. "The modern theory of the relativity of all human knowledge," says Rev. Clarke in his *Logic*, "leads to philosophical skepticism; if all knowledge is relative, absolute truth disappears from the face of the earth."

In answer to Rev. Clarke, I quote Dr. Carus: "It is this very relativity of knowledge, so often impugned, that allows an indirect, yet most reliable, apprehension, where direct observation is impossible." I refer the reader also to Dr. Karl Pearson's *Grammar of Science*.

As a matter of fact, the final result of radical skepticism is disintegration and dissolution: since it applies but one measure, namely: the ever changing "I," this ego-centric view-point is a psychological atomism. Applied to knowledge it is solipsism. In action its formula is nothing but "I." Anarchism is its result in practical politics. In metaphysics it is mechanico-atomistic naturalism and its all-embracing term is nihilism.

Take a grain of wheat, follow its evolution, study the labor required to form it into bread, and it will become evident how much we are dependent on and related to our fellow-beings. "All human life would perish, if the skeptic principle were to reign supreme," says Hume in his *Enquiry*.

In practice there is no nihilist, in theory only do we meet that fiction of an abnormal brain. The moment the nihilist would put into practice his principles he would destroy his own existence. All beings from the mower to man are related to each other and to the universe. We cannot think of existence without relations, hence it is the greatest error of the individualists, that any living being stands for itself "alone one," that it is "an only one." As the atom in energetics so the isolated individual is a fiction.

Haeckel's *Phylogeny* furnishes a proof. The life of the entire

chain of our ancestors and our progeny, in which we are but a link, and which surprises us at times with costly gifts, or loads our ship of life with fatal burdens, is the germ to which we owe our existence. We are the abbreviated race-history of our ancestry. The denial of this fact is insanity, for "nature is stronger than a principle" (Hume).

Nature rules by the punishment of destruction, of psychological degeneration and social discord, which is harmful to self-preservation, and still more so to the preservation of the species. Here we have criteria of truth, if not theoretically recognized yet practically operative and not to be disregarded. This condemnation of radical skepticism does not indeed include the skeptic attitude of mind which is so wholesome for science and true progress.

Now, since for practical purposes we are obliged to accept *criteria veritatis*, we have several ways by which it can be done. First, we may follow Plato and Spinoza whose principle was *conception*. By trusting in human understanding we are required to understand clearly and distinctly (*clare et distincte percipere*). The law here is this: Everything is a truth which does not contain a contradiction. Secondly, we may choose *revelation* as the irrationalists and philosophers of faith (the religions of revelation and their defenders, St. Augustine, Luther, etc.). The requirement is to believe in the revealed word of Sinai, Bethlehem or Mecca. Thirdly, we may accept *experience* as the empiricists (Protagoras, Epicurus, Stoa, scholastic nominalism, Bacon, Hobbes, Locke and their following). Here is taken for granted only what man experiences by or through his five senses.

Experience, or rather the conclusions drawn from the solution of the problem of experience, is seemingly the cause of the divergence between Kant and Hume. Experience, as Dr. Carus points out in his *Primer of Philosophy*, is an ambiguous term in Kant's terminology and may lead to confusion.

Kant seems to have misunderstood Hume, owing probably to the fact that Kant did not understand English. The translation of the *Treatise* by Jakob in 1790, came to his hand after the three critiques had been completed, and he had only seen the *Enquiry* prior to that. Nevertheless, some of Kant's criticisms of Hume are justified, namely, as regards the theoretical foundation of the validity of causation, while he believed in the validity of mathematics.

Impression is Hume's legitimation of truth, while Kant calls *atsight* (*Anschauung*) without conception blind, and conception

without at sight empty. Both views may be reconciled to the fact that experience is the determining criterion of truth. The conception of experience forms the stumbling block of reconciliation. Yet, everything points in Hume's favor and Hume's influence is growing. I mention Mach's psychological studies simply as a proof, as also Ostwald and Avenarius, all of whom may be called New-Humists; likewise Theodor Lipps in his foreword to the translation of the *Treatise on Human Nature*, where between the two (Kant and Hume) he apparently prefers Hume. That Hume was the first to found a biological theory of knowledge has been recognized by Alois Riehl, and also Windelband gives him the same credit in his *History of Modern Philosophy*.

If skepticism is limited to the consideration of metaphysics or means a denial of metaphysics, Kant can have no reason to criticise Hume, for in his *Prolegomena*, and in the last part of his *Critique of Pure Reason*, he also denied metaphysics. Hume is no skeptic in mathematics for which he accepts the view-point of rationalism. As far as the realm of perception is concerned we could almost call him a sensualist so strongly does he affirm perception. I rather class Hume as a relativist or positivist, like Comte and Mill. Hume's criterion could not satisfy the logician Kant, but did he himself find one more stable? However, both accept experience as the bottom rock of subjective certitude. Kant, the logician, naturally attempts the solution from the logical side, for which reason we see most logicians follow him to-day. The psychological side is Hume's contention, hence we find the psychologists and phenomenologists to a great extent among his followers. The causal theories in this controversy stand in the same relation that realism does to nominalism, if scholastic language be permitted. The problem does not lie in experience proper, but rather in the conclusions reached. The question of this divergency has received another solution by J. Mirkin from the mathematical side in his *Dissertation*, 1902, which may be compared with Dr. Carus' exposition of the Problem of Experience, in his *Primèr of Philosophy*. It is true as Dr. Carus states that Kant's misunderstanding may have been due to Hume's wrong conception of cause.

Hume's three principles of association of thought (similarity, identity, etc.) are, in my opinion equal to Kant's synthetic judgments *a priori*. That there are psychological truths, establishing a coercion at sight, is Hume's claim, and that there are logical truths which include a coercion of thought; these claims are perhaps more valuable

than Kant's schematization, which has been shattered by Adikes. Even his student Schopenhauer may be mentioned in this connection. The logical truths of Hume embrace the Kantian categories according to Mirkin.

Kant's criticism never holds good when it relates to the view Hume held on mathematics. Kant criticised the *Enquiry*, not the *Treatise*, as is proved by two passages in the latter. Here Hume himself states that the deduced propositions of mathematics can be obtained by sense observation, i. e., in Kant's language, they are synthetical. Hume has grasped the problem of knowledge much better than Kant by his careful distinction of conceptual (mathematical) knowledge and the knowledge of facts. (Leibnitz' *veritates aeternae et veritates de factu*.) Kant in this regard turns against himself. The conception of substance has been more completely destroyed by Kant's predecessors than by himself. Again: "Nor can there remain any suspicion that this science is uncertain and chimerical; unless we should entertain such a skepticism as is entirely subversive of all speculation, and even action. To throw up all at once all the pretensions of this kind may justly be deemed more rash, precipitate, and dogmatical than even the boldest and most affirmative philosophy" (*Enquiry*). What does that mean, skepticism or criticism? And again: "Mathematics is justified because its synthetical judgments *a priori* are established in the pure insights of space and time. Is there such a thing for metaphysics? No. Hence it is unfounded" (Kant).

Hume in his *Treatise* says: "The conception of existence does not differ from the conception of a thing."

Kant's assertion in the *Prolegomena* and the second edition of his *Critique of Pure Reason*, that "Hume cut off from the field of knowledge pure mathematics," falls flat if one reads the *Treatise*. Part 4 of the *Enquiry* led Kant to this error. Kant indeed lets the understanding give rise to the synthesis, instead of Hume's imaginative faculty. It is further true, that wherever Hume places belief in the external world or in the validity of the categories forming it, Kant speaks of necessary *a priori* present functions of the understanding, which condition experience, or rather first make it possible.

Humists call experience complexes of sense-impressions which by means of general habit involve a psychological coercion etc.... the product of an imaginative faculty is an instinct, which manifests itself in the belief of the external world. The instinct and belief are sufficient for Hume. Kant calls that skepticism. Such criteria

are too effeminate. Although Kant accepts the productive, imaginative faculty also, its function of unification of "synthesis" returns in Kant's transcendental unity of apperception, the silently accompanying "I" in thought, which accompanies all our notions in a latent state.

Forms of at-sight (space and time) and forms of thought (categories) take the place of imaginative faculty and belief. The divergency, it seems to me, is a question of temperament and consequence. Hume traveled a great deal, lived in France and came in contact with practical life almost daily, while Kant buried himself in his books, excepting only his walk to the university or his promenade with Lampe on the "Philosophen-Steg." He was like a wound-up clock, and Heine says of him that people used to set their watches according to his movements.

Kant looks on the problem of experience from a logical side, Hume from the psychological. Kant is a realist of conception and his sense of order comes in conflict with the relativist or nominalist. Experience is the product of thought in the *Anschauung*. A judgment must precede the impression before it becomes experience, it is the *conditio sine qua non*. Experience follows understanding. Hume says experience follows the faculty of imagination. But such an assertion would attribute the function of synthesis to the imagination, while the understanding has this function according to Kant. The form, in regard to the function which realizes it, is the act of the union of matter; by its means the isolated states of the parts are overcome. That which is individual in the impression is connected in our consciousness. In this connection I mention Lewes, *On Sense Verification*.

The real problem is this: How does the unity of sensation arise from the plurality of impressions? The best answer that I can find is given by Dr. Carus in his books *The Soul of Man, Whence and Whither?* and *The Religion of Science*. Hume says that it is the product of habit; Spencer, that it is inherited (biological); Kant, that it is a creation of the understanding. The pre-existence of conceptions, I think, we may discard, for how could the anthropoids have these forms of at-sight or the categories?

As is seen, Hume's synthesis is formed by imagination and faith, and Kant's by sensuousness and understanding. The causal problem was correctly put by Hume, Kant admits, for logically no one can expect that if I say one, two necessarily is to follow. Hume explained this biologically, Spencer led those postulates of Hume

to a consequent conclusion. Hume did not recognize that causes are successive stages of a routine experience, that necessity belongs to the world of conception, not to that of perception.

Hume chose the biological and only correct point of view, whence, however, Kant again departed. Kant knew and applied this view-point in his *Theory and History of the Heavens*, but in regard to the inner cosmos, the laws of the development of human consciousness, he was wrong.

The mere sense-impression is as little to Hume as experience is to Kant. Experience is the synthesis of the manifold impressions with the unity of an act of consciousness. But whence this synthesis, this function?

Hume as well as Kant answers, from two sources. But the former traces it from psychology; the habit which generalizes the uniform process of the life of nature, the belief in the correctness of our own psychological instincts: and from a logical source; the relational conceptions (identity etc.) and the category of relations. While Kant derives it from sense-perception and understanding which in their deepest root may be identical.

I might ask Kant, where does the parting wall lie between man and animal, and when begin these *a priori* insights, and the forms of thought, our birth-dress, in their souls which to him seem to be like *creatio ex nihilo*? Darwin and Spencer show that they developed. The psychology of Hume went deeper than Kant's, hence Hume comes closer to the results of present researches than Kant does. Hume gave the incentive to Stallo, Clifford, Mach and Ostwald. "Logical truths relating to the proposition of identity are irrefutable," says Hume, and he is apparently right. Mathematico-analytical laws are unconditioned and their contraries are unthinkable, while empirico-natural laws (gravity, conservation of energy, etc.) are valid under restrictions only.

The mathematical laws are apodictic, the physical laws are only assertory. The discovery of the different rays, radium etc., cannot be reconciled with atomic and ether theories, and science dropped the law but not the fact; therefore Hume is right. *Ergo*: Every natural law is valid, because it is based upon causality, hence we rely on experience, until it is reversed by new facts. The fact of experience is the criterion of truth, not the conception, not revelation. Thus it is seen that Hume is right. Kant, the rationalist, stuck to the pre-existence of conceptions, but how are we to reconcile his idea with the researches in biology and psychology? Hume

finds an explanation for Kant's ready-made functions. The symbols of mathematics and their values are human inventions, creations, and their conclusions cannot be canceled by any new facts. But the universe is not made of such numbers, angles etc., hence our logical truths (our creations) are incontestable. In this regard Helmholtz adheres to Kant while the New-Humists follow Hume. It is Hume who said: "Logical truths based on the principle of identity are irrefragable. No experience can add to or detract from these facts."

What are our analytical judgments? Nothing but those ideas which have been previously combined by synthesis and can be evolved from the combination. This means that they are ours by ancestral inheritance which is discovered as soon as we open the safe of logic. As long as we deal with logico-mathematical truths like Euclid's theorems our generalizing judgments remain valid.

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THEORY OF LIMITS.

In *The Monist* of July, 1905, in an article entitled "A Circular Polygon," Mr. Baker states that "the subject of limits as taught in elementary text-books is very crude and fogged with lack of perspective."

To this statement careful students will doubtless agree, but they will not likely accept all other conclusions expressed in the article.

If, as a variable assumes successive values *according to a given law*, it can be made to differ from a constant by as little as we please, but cannot be made equal to it, the constant is called the limit of the variable.

Of course, if the law of formation of the successive terms is altered, the limit may be altered, or may no longer exist. Thus in the examples given, in one case the horse gets out of the stable and in another case he does not.

But even this definition of a limit assumes that the constant has an existence independent of the variable. In many cases the limit is tacitly postulated and properties assigned by analogy. I believe this is a very common fallacy in current proofs concerning limits. Writers considering only variables having rational limits

are apt to overlook the limitations of their methods and to make hasty generalizations.

For example, we readily see that the limit of

$$1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots$$

is the known number 2. But consider the series

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$$

By using similar methods can we say that "the sum is easily seen....to be exactly" some definite number, and that "there is no unattainable limit, no residual error"?

If a curve is a line no part of which is straight, there is *by definition* an insurmountable barrier to the derivation of properties of a curve from those of a straight line.

It would hardly do to define circles as lines of constant curvature, since the measurement of angles involves the use of circles, and also the definition would involve the length of curves in general—a problem not always satisfactorily dealt with in the case of the circle itself. Moreover, it is probably not until we study calculus that we can show that lines of constant curvatures do not include loci other than circles and straight lines.

A comparison of the properties of a variable figure with those of its limit is instructive, but we must not assume that the latter can be logically derived from the former. I do not believe we can derive the properties of a tangent to a circle from those of a secant, any more than we can derive them from those of a line without the circle and approaching indefinitely close to it.

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BOOK REVIEWS.

FOUNDATIONS OF SOCIOLOGY. By *Edward Alsworth Ross*. New York: Macmillan Co. 1905. 12mo, pp. 410.

One of the chief effects of the christening of sociology with this name in 1842 was that for a full generation thereafter more arrant nonsense was written upon the subject than had been written in any previous period of several times that length. Numbers of unaccountable and invariable laws of sequence of social phenomena were announced; while on the other hand such writers as Ferrier and Goldwin Smith denied the possibility of any science of history. It was certainly an advance upon this state of things when Mr. Lester Frank Ward, in 1883, inaugurated the doctrine that sociology rests upon psychology, that the only social forces are the desires of individual men, and that these are controllable just as physical forces are controllable. It was an undeniable advance even though it involved some error. It is true that individual impulses are the only social forces to the same extent as it is true that the characters of any race of animals are the characters of the individual animals of that race. But is this quite true? Every census of the United States shows that among the native whites there are a few more males under one year of age than there are of females, (in 1900 as 38 to 37), while among the negroes it is the other way (in 1900, as 102 to 103). Here is a characteristic of each race, as it lives in the United States. Yet it cannot properly be called a characteristic of individual whites and negroes, though it is a character of statistics of individuals. It might be said that the *causes* of statistical characters lie in the individuals. But this would be a confusion of thought due to not remarking that a noun in the plural number does not denote the same sort of object as the same noun in the singular, but a *collection* of such objects. For most nouns and for most purposes the distinction is insignificant. But for the noun "individual" it is highly important. A character of individuals which is not a character of any one individual is a character of a collection of which any member is an individual. It is not an individual character, but is a collective character; just as the character of a molecule is not a character of an atom, just as a character of an ocean wave is not a character of sea-water.

Professor Ross is a close adherent of the position of Dr. Ward. If our readers will permit us to use the word "impulse" to denote that real determination of man's nature to which desire corresponds in consciousness, Professor Ross's opinion is easily explained. He holds it to be axiomatic that nothing but individual desires are the sole true causes of all social phenomena.

unless external circumstances be called causes. "How differently," he exclaims, "should we conceive the tasks of crystallography if we could question the molecules and learn just why they comport themselves as they do! How otherwise should we describe chemical processes if the atoms could tell us of the affinities they obey!" These exclamation-marks bespeak an absence of doubt which is not easily reconcilable with much reflection on the subject. For upon the same principle it should not be personal desires, at all, that are the true causes of action, but the impulses of the individual cells of the person's body. It is hard to imagine how atoms think. Let us rather consider the case of those insects which take the most sedulous care to lay their eggs where their progeny will find suitable food, although neither they themselves nor any insect of their species has any experience of such eggs producing any living creature. If such an insect could tell us why she took such pains about the place in which she deposited her eggs, we know pretty surely what she would say. She would say, "I do it because I want to," or if she were of a metaphysical turn of mind, she might reply with the *hysteron proteron* that she did it because it afforded her gratification, the truth being more nearly that it affords her gratification because she has an impulse to do it. She certainly would not dream of giving the biologist's answer, that she does it because the instincts of her race suffice for the preservation of the stock. Is her answer so much more adequate an explanation than this of the biologist as Professor Ross's exclamation-points would imply? If we are asked how we know that she would answer as we have said, we reply that we infer that she would because men give analogous answers. Ask a man why he does something, why he entertains the purpose that he alleges in reply, and push your interrogatories, and you will very soon come upon one of those forms of desire which are common to all men, and of which the individuals have no explanation to offer. But such instinctive desires seem, in all cases, to be favorable to the preservation of the stock. Thus, a drunkard drinks "because he wants to drink"; and it seems to be conducive to the preservation of the race that he should go on drinking, since he will so diminish the number of his probable offspring that will reproduce in their turn. Professor Ross would no doubt say that the drunkard's desire for drink, like the insect's desire to lay her eggs in a peculiar case, is a first cause of which no explanation will ever be possible. Few psychologists will agree with him. He does not perceive that a proposition asserting that every social law has this or that character is itself the enunciation of a true or false social law, and furthermore of a law which does not consist in individual desires; so that, if any such proposition be true, there must be at least one social law which does not consist in individual desires.

Professor Ross raises another objection against the logic of every general law which has been put forward and which does not consist in individual desire. The objection is that all such laws "rely unduly" upon the analogies of other sciences. But how does he prove this extraordinary law that a sociological law suggested by a similar law in another science is necessarily false? He professes to prove it by the analogy of other sciences. So here is a law resting solely on the analogy of other sciences which law declares that every *other* law like itself is false,—for no doubt it makes an exception in its own favor. But there are three very substantial replies to be made to this

sweeping objection. The first is that, so far is Professor Ross from historical truth when he says that "no recognized science borrows its laws from other departments of knowledge," that there are very few sciences which have not passed through crises in which the fogies have made a great outcry against the analogical extension of some principle from another department of study; and these crises have for the most part resulted in the confirmation of the analogy. Thus, paleontology originated in a violent protest against those who proposed to explain fossils by the analogy of the skeletons and other remains of known animals and plants. One of the crises of astronomy came when certain astronomers proposed to extend the "natural motion" of terrestrial bodies to the celestial bodies. The fogies insisted that "nothing was gained" by comparing two kinds of bodies so radically different. Physiology had its crisis when explanations of vital phenomena were first drawn from the analogies of inorganic physics and chemistry. Chemistry had its crisis when organic bodies were first explained as analogous to inorganic bodies, and organic chemistry was thus reduced to the science of carbon-compounds. Logic had one crisis when it was explained by the analogy of quantitative algebra; and it had another when the logic of relations was explained by the analogy of Boole's algebra of logic. Optics saw a struggle when it was proposed to explain light by the analogy of waves. So it runs all through science.

The second reply to the above objection should be prefaced by the remark that the analogical extension of a principle from one science to another does not take place according to that form of argument to which a strict ethics of terminology requires that the term "the argument from analogy" should be limited. That argument occurs when there are a number of objects, A, B, C, D, etc., and a number of characters *a*, *b*, *c*, *d*, etc., each of which characters is possessed by each of those objects, and when there are an additional object Z, and an additional character *x*, such that Z is known to possess each of the characters *a*, *b*, *c*, *d*, etc., and *x* is known to belong to all the objects A, B, C, D, etc. These premises constitute a relatively strong probable argument that Z possesses the character, *x*.

But there is seldom or never any argument of this strength, at the outset, to support the extension of a principle from one science to another. In the first instance, an examination of facts shows some of them to have a character which they certainly or probably would have if the extension were valid. This is an argument of a kind that has been called an abduction. It suffices only to show that the facts are more or less like what they would be if the theory of the validity of the extension were true. In that sense, and in that sense only, this argument from consequent to antecedent renders the theory "likely." It suggests that theory, and prompts an inductive investigation. This inductive investigation must not, like the abduction, begin with a scrutiny of the facts, but with a scrutiny of the theory, in order to find necessary consequences of it which are capable of being compared with the facts. In other words, it requests the theory that is on trial to predict the results of observations yet to be made, and which it should be able to predict if it be a true theory. When some considerable predictions based on the theory have been verified, while none have been falsified, the theory ought to be regarded as provisionally established. Now it cannot be disputed that the inductive testing of sociological theories by predictions or quasi-predictions has usually

been of a very slight kind; and it may be that Professor Ross, with his intimate acquaintance with sociological literature may be able to specify cases in which the mere abductive argument has been offered as sufficient proof. But as far as the reviewer is aware, it never has been pretended that it had any value other than as a suggestion. Now Professor Ross himself admits that "the extension into the social sphere of regularities discovered in other fields has greatly helped to bring order out of chaos." That being the case, he has altogether failed to show that there is any definite sense in which his wholesale condemnation of a general "undue reliance" upon analogy has any justification.

The third reply to Professor Ross's objection to the "undue reliance" upon analogy,—that is, upon the mere abductive argument,—is that he has not, with all his great learning, been able to adduce a single marked example of such least intention of defending the truth of those laws. We think the evidence of them is flimsy. But we do protest that they do not exemplify undue reliance upon abductive reasoning, since they do not take their rise in the observation of analogies, but in an *a priori* argument that in the nature of things there *must be* such analogies. Spencer maintains that a society is, and must be, built up of individuals, just as the individual is built up of cells, and therefore there *must be* a perfect parallelism between the laws of individual phenomena and of social phenomena. He thereupon proceeds to trace out this parallelism in detail, and finally he offers more or less inductive evidence in confirmation of it. One may deem such an argument stronger or weaker than if it relied upon observed analogies; but it certainly has a widely different character from such an argument and altogether fails to illustrate that "undue reliance" upon an observed analogy of which Professor Ross complains.

We certainly should not have gone to the trouble of making the above criticism if it were not that, in spite of them, Professor Ross's work is a strong and valuable one. The style is sufficiently simple and agreeable, and is occasionally brightened by an apt metaphor or telling phrase. "Race suicide" of which we have heard so much is a term of Professor Ross's invention. The book carries the reader along, and gives not merely the author's own views but all the chief general sociological theories of the day in such a way as to impart a lively interest in each one singly, and still more in the disputes to which their conflicts give rise. In this respect, Professor Ross shows a talent that is all his own. The book is moreover rich in illustrative facts; and our readers will thank us for calling their attention to it.

C. S. P.

THE WORLD'S DESIRES, OR THE RESULTS OF MONISM. By *Edgar A. Ashcroft*. London: Kegan Paul, Trench, Trübner & Co., 1905. Pp. xi, 440.

Edgar A. Ashcroft is an Englishman who possesses sufficient earnestness and boldness to treat the religious problem with frankness and enthusiasm, a case which is quite unusual in England if we except the small party of free-thinkers who excel mainly in negativism and combativeness.

The title of the book is explained in the following paragraph quoting from the end of the Introduction:

"The sum of the best products of the world's thought and the world's

experience, ripened to fruition by the truly marvelous progress of nineteenth-century scientific discovery, now offers for this purpose—to satisfy the soul's needs of humanity; to enable mankind to bring his beliefs and his life into logical accord and harmony with his advancing intelligence and experience—a new religion, or an old philosophy, call it which we will, which is summed up in the title 'Realism'; and we believe that a general acceptance of this religion and its carrying out on a national and international scale, will satisfy the world's desires, and stimulate and foster the growth and advancement of mankind, by natural processes, to an extent, and possibly at a speed, which will prove surprising to minds schooled, as are ours, to the pessimism of a dualistic or passive agnostic outlook. Only then, we believe and shall attempt to show, can mankind walk in the narrow pathway that leads to reality; and attain to those mansions of the Blest, which are potential possibilities for the human race, as foreshadowed by the ideals of its numerous creeds."

The author, though very critical in religious matters, and following the lead of Ernst Haeckel, is anxious to have the religious and sentimental needs of mankind satisfied. He wants guidance in life and tenable ideas based on truth (see page 33), but he finds the established religions lacking in scientific truth, and philosophical and scientific reformers not sufficiently appreciative of the needs of man's soul. For this reason he ventures to build up a religion of his own, and quotes the old hymn:

"Faith will vanish into sight,
Love in Heaven will shine more bright,
Therefore give us love."

He sums up his aim in the following words:

"Let us borrow and re-apply the ecstatic words of St. Paul and express our thoughts thus: 'Eye hath not seen nor ear heard, neither have entered into the heart of man to conceive, the things which God hath prepared for those that love him.' We care not for the word 'God'! The human emotions which prompted St. Paul to worship his God are the same feelings, the same properties of matter and its marvelous organisms, which induce in us the lofty contemplation, (if you will, worship), of all that is good, all that is true, and all that is beautiful. And the most beautiful, good and true things that life has revealed, in all its ages, to mankind, are just those organic phenomena of human love, sympathy and fellowship."

The main treatment of the book is a review of human knowledge and the application thereof to man's political, social and ethical life. It is here where the author in the interest of his main cause might have been economical. For though his review of human knowledge is very well done, all its details are not essential for the author's present purpose. Mr. Ashcroft looks to the future not exactly with glowing optimism but with confidence, and he expects that in the long run mankind will be organized so efficiently as to realize the ideals of a religion of science, of truth, or realism. This organized will of mankind is the ultimate aim of human history. Mr. Ashcroft says:

"The will must be so developed as to harmonize with all natural forces, and the intelligence so cultivated as to secure the power to gratify this will"

Mr. Ashcroft having explained the main truths of physics, chemistry and other natural sciences, proceeds to state that the most marvelous faith in the world is the rise of the human soul. He devotes considerable space to the mechanism of living organisms, and then points out the great truth that the development of character is the chief aim of man's life.

He concludes with quoting Henley's noble lines:

"Out of the night that covers me,
Black as the pit from pole to pole,
I thank whatever Gods may be
For my unconquerable soul.
In the fell clutch of circumstance
I have not winced nor cried aloud,
Under the bludgeonings of chance
My head is bloody, but unbowed.

"Beyond this place of wrath and tears
Looms but the horror of the shade,
And yet the menace of the years
Finds, and shall find me unafraid.
It matters not how strait the gate,
How charged with punishments the scroll,
I am the master of my fate:
I am the captain of my soul."

The author is so radical as to be an infidel in the eyes of the old-fashioned Christian, yet his sympathy with religious sentiment and his use of traditional religious phrases shows that he is kin in spirit with the notable religious minds of the past, and though the viewpoint from which he writes has radically changed, the moral earnestness and seriousness is the same as the spirit that pervaded both the Decalogue and the Beatitudes.

BUDDHIST AND CHRISTIAN GOSPELS. Now First Compared from the Originals. Being "Gospel Parallels from Pali Texts" Reprinted with Additions. By *Albert J. Edmunds*. Third edition. Edited with parallels from the Chinese Buddhist Tripitaka by M. Anesaki. Tokyo: Yuhokwan, 1905. Pp. xiii, 230.

This work is the culmination of some twenty-five years of scholarly research which Mr. Edmunds has given to the careful investigation of the canonical writings of Buddhism. His knowledge of these is as critically thorough as a theologian's knowledge of the Christian Gospels, and in the parallels he has drawn between the two canons he distinguishes on both sides between the most authentic text and later interpolations, and also apocryphal or extracanonical writings.

The parallels exist more in the spirit and intent of the passages quoted, than in the words. There are eighty-eight in all besides six uncanonical parallels which form an appendix. The first three deal with analogous details of the birth and infancy stories of both religions; then follow five dealing with the initiation of the two great teachers, the Christ and the Buddha; thirty-three more deal with incidents during the ministry of each leader and corresponding ethical teachings; the next nineteen compare similarities in

their characters and attributes, and the last division contains the closing scene of the two eventful lives followed by corresponding prophecies in the two religions about the future of the life of the Church and the eschatology of the race.

Mr. Edmunds's work is supplemented by that of the Chinese editor, Professor Anesaki, of the Imperial University of Tokyo, who adds parallels and notes from the Chinese Buddhist Tripitaka. The technical book-making of the Japanese publishing house is excellent, but it is greatly to be deplored that the distance between publisher and author made English proofreading impossible beyond what could be done in the Oriental house. In consequence many typographical errors have crept in which could not have appeared in an English-speaking country, and many others which should have had the author's personal supervision. The most important of these are corrected in a rather formidable list of errata. There are no such disadvantages, however, in the Chinese quotations which were inserted under the care of the Editor.

In an historical introduction of fifty pages Mr. Edmunds writes of the antiquity of the Pali texts and the place of the Nativity Suttas in the Buddhist canon, as well as a critical discussion of the texts of the Christian Infancy Sections which he believes "to be cast in the same mould of Asiatic legend." On the principle that nothing should be regarded as borrowed "unless proven by express reference, by identity of text or sequence of narrative accompanied by demonstrable intercourse," the author tries to inquire into a possible historical connection between Buddhism and Christianity. His arguments in favor of this conclusion are of general interest.

Alexander the Great took three thousand Greek artists and actors with him into India and these laid the foundation of a long intellectual connection between Hellenist and Hindu culture. Aristotle conversed with a Jew in Asia who belonged to a sect around Damascus that was derived from the Hindu philosophers. Aristotle says that he received more information from this man than he gave in return. Alexander had decreed that there should be intercourse between Europe and Asia so that the two continents might become homogeneous and established in mutual friendship. His successors were animated by the same spirit and, working to the same end, sent ambassadors to India with instructions to write a description of the country. A Hindu king of this period sent to Antioch for a sophist, and his son Asoko (3d century B. C.) brought Buddhism to the notice of the Hellenist kings. Clement of Alexandria and others quote passages from a writer of Asia Minor that show a knowledge of Buddhism and other non-Brahmanic sects. About 110 B. C. the Greek king Menander (in Pali, Milindo) had a discussion with a Buddhist sage which is preserved to us in the Questions of King Milindo. This work (in which the Pali Pitakas are first immanent) shows that intelligent Greeks were inquiring into Hindu philosophy. Later, in the time of Augustus, Horace mentions an Indian embassy to Rome. In the time of Christ, Strabo saw a hundred and twenty ships ready to sail from the Red Sea to India, and coins of all the Roman emperors from Augustus to Hadrian are in the Museum at Madras. The title "good physician" as used in the apocryphal Acts of Thomas is not Christian but Buddhist. It does not occur in the New Testament but is found in the Buddhist canon.

"In the first century, or perhaps in the second, there reigned in the valley of the Indus the Buddhist Emperor Kanishka, whose famous council did so much to give political prestige to patristic Buddhism. One of this monarch's coins, which has come down to us, actually has on it the image of Buddha, with his name in Greek letters:

ΒΟΔΔΟ

"Wherever this coin circulated the name of Buddha would be known, and many a Greek may have seen it for the first time thereupon."

In the first century people from India were living in Alexandria and the influence of their fables is traceable in the Talmud; and in the same century a manual of the Egyptian trade with India was written. Within about two centuries of the beginning of the Christian era mention was made by Virgil, Horace, Pliny and Clement of Alexandria, of distant people of Hindu origin who, according to the descriptions of these writers, are presumably none other than the Buddhists in China. Two incidents of the second century are noteworthy: (1) the mention of Buddha by Clement of Alexandria, and (2) the finding of the Gospel of Matthew in India, and by the end of the fourth century the doctrines of John had been translated by the Hindus as well as by the Syrians, Egyptians, and Persians. Possible allusions to Christianity have been noticed too, in the great Indian epic, the Mahabharata.

By these and many other incidents Mr. Edmunds shows the possibility of intercourse between the East and the West in the times of the establishment of Christianity; between Rome and the Ganges by way of Alexandria, Antioch and Bactria. This intercourse being proven he tries to show that Buddhist influence is traceable in the Gospel of Luke and this not in identity of text (except a partial verbal agreement between the Angelic hymns) but rather in the matter of sequence of narrative.

DER VORCHRISTLICHE JESUS. Von *William Benjamin Smith*. Mit einem Vorworte von *Paul Wilhelm Schmiedel*. Giessen: Alfred Tötelmann, 1906.

William Benjamin Smith's work on the prehistoric Jesus, published in a German translation before the original appeared, and prefaced by his most eager antagonist Prof. Paul Wilhelm Schmiedel of Zürich, is a most remarkable phenomenon in the history of theological literature. Theologians as a rule are suspected of partiality, and the *furor theologicus* has become proverbial, yet Professor Schmiedel who represents the traditional and more orthodox stamp, deems it wise to have this most radical conception of the origin of the Christ ideal made accessible to the German theologians. He explains in the preface that these errors need refutation, and if they are errors they ought to be easily refuted, yet finding them so ably presented he challenges his colleagues to assist him in working up the field and combating the common danger.

Professor Schmiedel sums up Professor Smith's theory as follows:

The doctrine of Jesus is pre-Christian. It is a cult which between 100 B. C. and 100 A. D. had become current among Jews, and especially among the Hellenists, veiled more or less in mysteries. Christianity took its origin from several foci, and only according to a later theory from one alone, viz.,

Jerusalem. Jesus was from the beginning nothing but a deity, namely,—the liberator, the preserver, the saviour, the Nazarene. He was called Nazarene not from a town Nazareth, which in those days did not exist, but according to the Hebrew sense of the word, viz., the preserver. His *anastasis* meant originally his being put up in the sense of being installed, viz., as Messiah, the dispenser of the world and judge of the quick and the dead. Later on the addition "from the dead" modified the meaning of the term which henceforth signified "resurrection." There were two doctrines, first the one of John the Baptist, more severe and stern, proclaiming the advent of the Christ, the Messiah; and the other more gentle one of Jesus. These two were originally different movements, but they were finally merged into one religion culminating in the ideal of Jesus Christ.

Further, Smith claims that the Epistle to the Romans was not known before the year 160 A. D., and its authenticity is thereby seriously questioned. Professor Schmiedel has risen as an adversary to Smith, and has criticized his view in the *Hibbard Journal*, January, 1903. Accordingly, Schmiedel can not be accused of being a partisan who advocates Professor Smith's cause for trivial or personal reasons. On the contrary, he introduces him to the theological public because he deems it a duty to have the problems of Professor Smith discussed, and if possible finally disposed of. These questions Schmiedel claims are not unessential accidents, but the most essential part of Christian doctrines forming the foundation of our religion.

Professor Smith, though not a theologian, (for he is professor of mathematics at Tulane University) is so well equipped in theological knowledge that he deserves a hearing, and a refutation of his views will prove no easy task. The book needs deep study and can not be hurriedly digested, for the array of facts is formidable and learned, and it takes a special theologian to enter into Professor Smith's arguments. Specimens of his work have appeared in the *Hibbard Journal* and in *The Monist*. The *Hibbard Journal* contained an article on the Epistle to the Romans which is analysed into several fragments of different origin. His *Monist* article treats the very difficult problem of the Nazarene, in which for the first time he propounds his theory of Jesus the Nazarene as a pre-Christian deity of a Gnostic sect. The present book is not yet a complete exposition of Professor Smith's theory, but merely a preliminary statement of its most essential points fortified by argument, the strength of which seems to take hold of the reader gradually. The book contains five chapters: (1) The Pre-Christian Jesus. (2) The Meaning of the Epithet Nazorean, (3) Anastasis, (4) The Sower Sows the Logos. (5) *Sæculi Silentium*.

We have set forth our own views concerning the origin of Christianity in a number of articles published partly in *The Monist*, partly in *The Open Court*, and we find Professor Smith's views similar in many respects. Like him we insist that Christianity has originated from a pre-Christian movement, and almost all its essential doctrines have been prepared by religious sects which were more or less due to the syncretism that originated from the mixture of the nations after the conquest of Asia by Alexander the Great. Gnosticism was a pre-Christian movement, and the religion of the Nazarenes was one among many kindred movements. Mithraism, the reverence shown to Apollonius of Tyana, the Greco-Egyptian sects such as the Therapeutæ.

also the worship of Hermes Trismegistos as the divine word, and the continuation of the worship of Ptah, the word from whom the world had been made, were products of the same general movement. It is therefore quite natural that on closer investigation all these different faiths are found to be similar. They all teach an immortality of the individual soul; they are more or less dualistic; they show a tendency toward asceticism; they hold fast to the belief in a universal religion, or at least in the universality of religious truths; they proclaim a mediator between God and man, an incarnation of the deity or representative of God on earth, either in the shape of a mythical personality such as Mithras, or the incarnation of a sage such as Socrates, Apollonius of Tyana, or Jesus the Nazarene. This new religion that is preparing itself is really the essence of the sum total of all the pagan religions preceding Christianity in its ideas of the God-man, the Saviour, the remission of sins, the resurrection of the body, the renewal of the world, the establishment of a kingdom of heaven on earth, and kindred hopes. Hence have arisen many pre-Christian movements anticipating such Christian doctrines as the trinity, which is definitely provable in the case of Simon Magus, the existence of wandering preachers like Apollos who taught the Christ and was conversant with the doctrines of "the Lord," without ever having heard of Jesus. Among these prophets of the new religion there were many Jews, who on account of their rigid and iconoclastic monotheism we must assume played a very prominent part, and St. Paul among them succeeded in focusing this worldwide movement upon Jesus. If he had not succeeded in his aspirations, if some other rival sect had succeeded in establishing itself we might have other names, perhaps also other sacred scriptures, but the new religion would have practically become the same in doctrine and ethical ideas. It would have passed through the same phases of dualism and in general outlines would have followed the same course of development. If for instance Apollonius of Tyana had become the deity of the new faith, the Platonic, Neo-Platonic or Stoic writings would have become to us what the Old Testament is now to Christians. If the Mithraists had been victorious, the Zendavesta would have taken the place of the Hebrew scriptures, and our theologians would study the Gathas in place of the prophets. They would look upon Zarathushtra as the great prophet of antiquity who had prepared the way of the saviour.

Professor Smith corroborates this general conception concerning the origin of Christianity, yet he goes beyond it. He establishes in addition some details concerning the very origin of the idea of Jesus as a Nazarene and for the first time shakes our belief in the authenticity of the epistles of St. Paul, which heretofore had been accepted as genuine even by the most radical critics. We might add incidentally that the conservative class of German theologians slowly follow in the wake of the same general tendency. We will call attention to Professor Pfeleiderer's distinction between Jesus and Christ, which implies that Christianity as it is interpreted in orthodox quarters is practically a Jesuanity, and that in order to become true Christianity, it would have to overcome the historical error of the identification of Jesus and Christ.

We have watched Professor Smith's publications with great interest, and though we are not prepared to follow him in all details, we are convinced

that he should have a fair hearing, and that his labors will considerably promote the solution of the main problems of New Testament theology.

DER DOPPELTE STANDPUNKT IN DER PSYCHOLOGIE. Von *Mary Whiton Calkins*.
Leipsc: Von Veit, 1905. For sale by C. A. Köhler & Co., 149 Tremont
St., Boston. Pp. 80.

By double standpoint, Prof. Mary W. Calkins does not mean the parallelism of Weber, Fechner, Wundt and others who have made use of the term to express psychical phenomena in physical terms, but the two opposite view-points which are present in psychology. There are two schools: one looks upon soul as a combination of psychic states, and interprets them to be realities of life; while the other assumes the existence of a soul, and interprets those sentiments, volitions, etc., as the manifestations of the soul. It goes without saying that either the soul is, as the traditional soul-conception teaches, an absolute unit; or it is as Wundt says, a unification of units which is not absolute, but the product of organization. *Tertium non datur*. If Professor Calkins attempts, nevertheless, to reconcile the two positions, she does so because she feels that the old traditional view is no longer tenable, and that she has to utilize the data of psychophysics. In fact most of the detailed work of her exposition draws largely upon experimental psychology, which is merely a branch of psychology, and, as it is frequently treated in our laboratories, proves too unsatisfactory to be acceptable as a theory of the soul.

The work of many latter-day psychologists is very insufficient and leaves out of sight some of the most significant features of soul-life, as those features which depend upon character or are experiences of personality as such. A study of their lucubrations, or their experiments, or their expositions, makes one feel like the wanderer, who could not see the woods because of the many trees. Everything is detail, and nowhere is the soul of man as a whole taken into consideration. The truth is that the soul is not a conglomeration of unrelated impulses, but that its unity is the most significant factor in the correlation of the diverse psychic elements that constitute a personality. While we thus support the cause of a monistic psychology we appreciate the significance of the old interpretation, and can very well understand that Professor Calkins does not want to part lightly with some of its most important truths. The result is that she chooses from each side what appeals to her as best.

DIE ERKENNTNISTHEORIE DER NATURFORSCHUNG DER GEGENWART. Von *Dr. H. Kleinpeter*. Leipsc: 1905. Pp. xii, 156.

Professor Kleinpeter sums up in this handy little volume the essential features of the modern conception of science, especially modern science, in which the views of Mach, Stallo, Clifford, Kirchhoff, Hertz, Pearson and Ostwald, have been made the foundation of the naturalist's world conception. It is one which discards the revision of the old philosophy, and bases the new philosophy absolutely upon experience. The problems of the book deserve careful and special attention, and we hope that we shall find an opportunity to discuss the difficult points in this new materialism which is at present governing the leading minds of science.

FOUNDATION OF A LAY CHURCH

WHAT is the reason that so many people, and sometimes the very best ones, those who think, stay at home on Sunday and do not attend church? Is it because our clergymen preach antiquated dogmas and the people are tired of listening to them; or is it because the Churches themselves are antiquated and their methods have become obsolete? To many these reasons may seem a sufficient explanation, but I believe there are other reasons, and even if in many places and for various reasons religious life is flagging, we ought to revive, and modernize, and sustain church life; we ought to favor the ideals of religious organizations; we ought to create opportunities for the busy world to ponder from time to time on the ultimate questions of life, the problems of death, of eternity, of the interrelation of all mankind, of the brotherhood of man, of international justice, of universal righteousness, and other matters of conscience, etc.

The Churches have, at least to a great extent, ceased to be the guides of the people, and among many other reasons there is one quite obvious which has nothing to do with religion and dogma. In former times the clergyman was sometimes the only educated and scholarly person in his congregation, and he was naturally the leader of his flock. But education has spread. Thinking is no longer a clerical prerogative, and there are more men than our ministers worthy of hearing in matters of a religious import. In other words, formerly the pulpit was naturally the ruler in matters ecclesiastic, but now the pews begin to have rights too.

Wherever the Churches prosper, let them continue their work; but for the sake of the people over whom the Churches have lost their influence the following proposition would be in order, which will best and most concisely be expressed in the shape of a ready-made

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It is proposed to form a congregation whose bond of union, instead of a fixed creed, shall be the common purpose of ascertaining religious truth, which shall be accomplished, not under the guidance of one and the same man in the pulpit, but by the communal effort of its members in the pews.

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The Lay Church will establish a free platform for diverse religious views, not excluding the faiths of the established Churches: provided the statements are made with sincerity and reverence.

Since The Lay Church as such will, on the one hand, not be held responsible for the opinions expressed by its speakers, and, on the other hand, not be indifferent to errors and aberrations, monthly meetings shall be held for a discussion of the current Sunday addresses.

The man of definite conviction will find in The Lay Church a platform for propaganda, provided it be carried on with propriety and with the necessary regard for the belief of others: while the searcher for truth will have the problem on which he has not yet been able to form an opinion of his own ventilated from different standpoints.

It is the nature of this Church that its patrons may at the same time belong to other Churches or to no Church. And membership does not imply the severing of old ties or the surrendering of former beliefs.

The spirit of the organization shall be the same as that which pervaded the Religious Parliament of 1893. Every one to whom the privilege of the platform is granted is expected to present the best he can offer, expounding his own views without disparaging others. And the common ground will be the usual methods of argument such as are vindicated by universal experience, normally applied to all enterprises in practical life, and approved of by the universal standards of truth—commonly called science.

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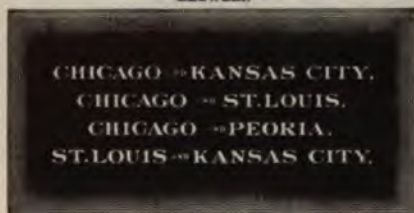
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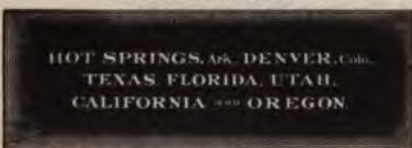
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THE MONIST

PRAGMATISM AND MATHEMATICAL LOGIC.*

IT is certainly not one of the least of the merits of the *Leonardo* that it has established lines of communication and encouraged the exchange of ideas between exponents of philosophical studies belonging to the most diverse and distant intellectual fields—between logicians and estheticians, between moralists and economists, mathematicians and mystics, biologists and poets.

Pending the possibility of a comparative examination of the results obtained, or prepared, by the development and exchange of ideas in all these various directions, it will not be irrelevant to summarize here in a schematic synopsis such of these results as relate to one of the most important lines of communication which the *Leonardo* has helped to construct and keep in operation, that is, the line which joins the various domains of Pragmatism with those occupied and cultivated by the “mathematical logicians.” A significant indication of the intimate connection between these two fields of philosophical research may be deduced from the fact that the sponsor of the denomination and concept of “Pragmatism” (Ch. S. Peirce) is himself likewise the initiator and promoter of an original trend in logico-mathematical studies.

It is not, however, from the labors of the school of

* Translated from the Italian by H. D. Austin. This paper appeared originally in the *Leonardo*, Feb., 1906.

Peirce, but rather from those of the Italian school, headed by Peano, that I purpose here to take my material for the determination of what might be called the "pragmatic characteristics" of the new logical theories.

* * *

One point of contact between logic and pragmatism is found in their common tendency to regard the value, and even the meaning, of every assertion as being intimately related to the use which can be made, or which it may be desired to make, of it for the deduction and construction of particular consequences or groups of consequences. This tendency is manifest, among the mathematical logicians, especially in their revision of the criteria employed in the choice and determination of *postulates*, that is, in the choice of those propositions which in each separate branch of deductive science are to be admitted without demonstration. Instead of conceiving of the difference between postulates and the other propositions which are demonstrated by means of them as consisting in the possession on the part of the former of some special character which renders them *per se* more acceptable, more evident, less disputable, and so on; the mathematical logicians regard postulates as propositions *on a par with all the others*. The choice of such "postulates" may differ according to the *end* in view, and must, in any case, depend upon an examination of the relations of dependence or connection which may be established between these "postulates" and the remaining propositions of a given theory, and upon a comparison with the form into which the treatment as a whole would develop under conditions of varying choices. If the relations between postulates and dependent propositions might formerly have been likened to those which subsist, in a state under autocratic *régime*, between the monarch or the privileged class and the rest of the social body, the work of the mathematical logicians

has been somewhat similar to that of the inaugurators of a constitutional or democratic *régime*, under which the choice of the rulers depends, at least theoretically, upon their recognized ability to exercise temporarily determined functions, to the public welfare. Postulates have had to relinquish that species of "divine right" with which their pretended evidence seemed to invest them, and resign themselves to becoming, instead of the arbiters, the *servi servorum*—the employees simply—of the great "associations" of propositions which make up the various branches of mathematics. With this same tendency are connected also the requirements regarding the maximum reduction of their number and pregnancy, the exact determination of their applicabilities and spheres of validity, and so forth.

* * *

A second resemblance, of not less importance, between the pragmatists and the mathematical logicians appears in their common repugnance to the vague, indefinite, generic; and in their care to analyze every assertion into its simplest terms, whether referring directly to *facts*, or to *connections between facts*. It is thus that both constituencies have come, each for itself and in its own way, to recognize the unreality of a great part of the distinctions which have been handed down from scholastic logic to the modern "theories of knowledge," and to subject others of these distinctions to critical analyses from which they have emerged in a sense transfigured, restored, enriched with new and more important significances.

Thus, by introducing the conception of "possible definition" a clear recognition has been reached of the wholly relative character of the distinction between the "essential properties" of a given figure or mathematical entity and the other properties possessed by it. In like manner the distinction between affirmative propositions and negative, and that between particular propositions and

general, have been absorbed in the one and more important distinction between propositions affirming the interdependence of two facts and propositions affirming the *possibility* or the "*non-absurdity*" of the coexistence of two or more facts. This involves, too, the invalidating of the distinction between categorical and hypothetical general propositions.

The recognition of the hypothetical nature of general propositions has also helped to turn attention to the "tacit restrictions," or unspecified limitations, upon which their validity depends. A good example of this is the observation of Maxwell (cited by Roiti in his *Elementi di Fisica*, 1894, p. 65): that even the simplest propositions as to areas, *e. g.*, that "the area of a triangle is given by one-half the product of the base by the altitude," would cease to be true if, instead of taking as the unit of measure of areas the square with side of unit length, one were to take the triangle having such unit as base and altitude. These considerations are intimately connected with those by which the pragmatists have been led to a more precise determination of the difference expressed in ordinary speech by opposing "laws" to facts; and to put on an entirely new basis the classic controversy between determinists and freedomists. (See *Leonardo*, April, 1905, p. 57, and Poincaré, *Valeur de la science*.)

* * *

A third point of contact between pragmatists and mathematical logicians consists in the interest shown on both sides for historical researches in the development of scientific theories. Both consider these essential as a means of recognizing the equivalence or identity of theories, under the various forms which they have assumed in different epochs or fields—all the time expressing substantially the same facts and serving the same ends. The logicians as well as the pragmatists have thus contributed to destroy

a number of prejudices attributed to supposed incompatibilities between the theories now current and the views of the great scientists or thinkers of antiquity. The fact has been brought to light that many, and those not the least important, among the discoveries of modern mathematicians, have consisted in nothing more than the introduction of new methods or notation for processes formerly employed or considered under other names by their predecessors. In the *Formulario* of Peano the importance given to historical data has steadily increased, especially under the inspiration of one of the principal collaborators, Vacca (among other things an enthusiastic investigator of the development of mathematics in the Far East); and the importance attributed to articles of this kind now constitutes one of the most noteworthy among the distinctive characteristics of the method of treatment of the various branches of mathematics that the said *Formulario* presents. Theories are therein expounded, not as in the ordinary treatment, under their "static" aspect—as one might express it,—their aspect of repose; but under that of movement and development—not in the conventional attitudes of stuffed animals, with glass eyes; but as organisms, which live, eat, struggle, reproduce: or at least like figures in a cinematograph, with some naturalness of progression and development.

To this tendency to recognize the identity of theories, beyond or under differences of expression, symbolism, language, representative conventions and the rest, is to be attributed also the constant interest of the mathematical logicians in linguistic questions—from Grassmann, at once the author of the *Ausdehnungslehre* and of the *Wörterbuch zum Rig-Veda*, to Nagy, student of the transmission of Greek thought through the Syriac and Arabic commentaries; from Couturat, joint author with Leau of a History of the Projects of "Universal Language," to

Peano, inventor and propagandist of one of the most practical among them: the "*latino non flexo*."

* * *

Quite a different series of relations between pragmatists and mathematical logicians is offered by the important progress made by the latter in the theory of "definition."

First of all, the traditional method which makes definitions consist in the search for *genera* and *specific differences*, i. e., in the search for classes from which the class to be defined may result through the mediation of a "logical product," has been broadened so as to include every case in which the class to be defined may be obtained as a *function* of known classes, by means of any previously admitted operation or series of operations.

In another direction the scholastic methods of definition have been broadened by taking into consideration the cases in which that which is defined is not an isolated word but a group of words or phrases in which this word appears (*implicit definitions*). Hereby we have come to recognize more clearly than did, say, Aristotle, that definitions of isolated words are only a particular case, the simplest, in the vaster field of "implicit definitions." We see, for example, that to define a noun *A* signifies nothing more nor less than to indicate the sense which would be attributed to the phrase: "this thing or that is an *A*." Moreover it has become possible to characterize and justify the procedure, already instinctively followed by mathematicians, of employing successively diverse definitions of one and the same notation, according to the fields (whether inclusive or not) in which arises the opportunity of making use of groups of symbols in which this notation figures (definitions preceded by hypotheses limiting, and varying with, the variation of the definitions).

Particular interest, in their relations to pragmatism, is presented by what were called (Peano) "*definitions by*

abstraction"; in which, from the fact that a given relation presents some of the characteristic properties of equality, occasion is taken to fashion a new concept: as, for example, from the fact that two straight lines parallel to a third are parallel to each other, is drawn the concept "direction"; or, from the fact that two amounts of merchandise exchanged for one and the same amount of a third commodity are mutually exchangeable, is evolved the concept "value."

A character common to the latter and to the other above-mentioned innovation, among those introduced by the mathematical logicians into the traditional theory of definition, consists in their tendency to bring to light the various orders of circumstances upon which may depend the fact that of a given word, taken by itself, a definition in the ordinary sense cannot be given; that is, a phrase cannot be enunciated which will indicate directly the characteristic or characteristics belonging to the objects to which the word in question is applied.

Not only has mathematical logic led to a recognition of the fact that to speak of the "definability" or "non-definability" of a given word or concept is to use a meaningless phrase, so long as no precise indication is given as to what *other words* or concepts may be used in the desired definition; but it has also afforded an explanation of the fact that many among the most important words of science and philosophy are found to be among those very ones of which it is unreasonable to ask or to seek a definition, in the scholastic sense. Mathematical logic has thus contributed most efficaciously to the defense of the position of the pragmatists against the "agnostic" prejudice which attributes the impossibility of the resolution of such problems to a pretended incapacity of the human mind to penetrate the "essence" of things.

The so-called "definitions by postulates"—i. e., those

which consist in determining the significance of a sign of operation or of relation by enunciating a certain number of norms which, by hypothesis, are to regulate its application—have, on the other hand, affinities with pragmatism in that they conduce to a clearer recognition of the arbitrary character of postulates, as well as of definitions. These appear in their true quality as propositions which possess the function of determining, in view of given ends or applications, the various fields of research; that is, as propositions whose sole justification consists in the importance and utility of the *consequences* which it may be possible to deduce therefrom.

* * *

Another characteristic of mathematical logic, in which, perhaps even more than in any of the afore-mentioned, is shown its affinity to pragmatism, is that which relates to the function which has come to be assumed by the search for and construction of "particular interpretations," or concrete examples, as criteria for determining the mutual independence, or the compatibility, of given affirmations or hypotheses.

Originally considered as simply a means of ascertaining the *necessity* (indispensability) of given premises, or the impossibility of reaching determinate conclusions without their aid, this search for particular examples has come to be regarded as the *only* process capable of guaranteeing that any group of hypotheses does not contain "implicit contradictions." That is, the construction of concrete interpretations, by which all the premises or hypotheses underlying a given deductive theory may be simultaneously verified, has assumed the importance of a condition in the absence of which even the most rigorous lines of reasoning can lead only to conclusions liable to contradiction by others, which may be obtained through deductions not less rigorous *than the premises themselves*.

Furthermore, in the choice of examples *hierarchies* have come to be formed, according to their degree of concreteness and determinateness. To such of these as are the most concrete and determinate of all—i. e., to the examples which belong to the field of arithmetic—has been attributed for the above-mentioned purpose, by some, a superiority over all others; particularly over those which imply considerations of continuity, or which belong to fields in which it is found more difficult to effect an exact and complete characterization or formulation of the facts adduced.

In this need of reinforcement by particular facts which is inherent in the more abstract theories (and this need is in direct proportion to their abstractness)—not, indeed, a need of facts which shall serve to confirm or to render inductively probable the separate premises upon which they are based; but of facts which shall guarantee the possibility of the *coexistence* and *cooperation* of such premises:—in this need of pure logic to derive strength, like Antæus, from periodic contact with the earth, one cannot fail to recognize one of the most significant indications of that mysterious alliance between “the extremes of theoretic activity” (the intuition of the *particular* and the impulse to abstraction and generalization) which it is not the least of the merits of the pragmatic theories to have noted and proclaimed.*

* * *

Pragmatists and mathematicians find themselves in agreement, too, in their efforts toward the maximum of *conciseness* and *rapidity* of expression—in their tendency to eliminate all superfluity and redundancy both of wording and of concept.

Both find the value of theories and doctrines not only in that which is said but also in what is *unmentioned* and

* Cf. G. Papini, “Les extrêmes de l’activité théorique” (in *Comptes rendus du IIe congrès internationale de philosophie.*) Geneva: Kündig, 1905.

whereof exposition or consideration is suppressed. See the article of Giuliano il Sofista on the Nourishment of Fasting, (*Leonardo*, April, 1905).

One of the principal achievements of mathematical logic consists in this very recognition of the fact that so many of what pass for *mathematical truths* owe their existence solely to imperfections of notation, which permit the enunciation of the same fact in different ways—to have afterward the pleasure of recognizing it as one and the same under its divers expressions. An example of this is to be found in the propositions of trigonometry, which re-enunciate, in new garb, theorems of elementary geometry; and, furthermore, re-enunciate them in manifold forms, of which the trigonometrical identities do no more than to express the equivalence.

By the introduction of other new symbols the number of “truths” of this kind might be increased indefinitely—repeating in science the miracle of the multiplication of the loaves and fishes; with the difference only that the results thus obtained would serve much more to distend than to nourish the minds to which they should be communicated. Indeed in this connection, as my friend G. Vacca observes, one might enunciate a law in form analogous to Malthus’s Law, consisting in this: that when the concepts or the words which are introduced into a theory increase in arithmetical ratio, the corresponding propositions—whose truth or falsity the “science,” to be complete, must needs decide—increase more rapidly than any geometrical progression (following an exponential law, enunciated by Clifford. See Peano, *Calcolo geometrico*, 1888).

Against a similar fatty degeneration of theories pragmatism, likewise, represents an energetic reaction; insisting as it does on the *instrumental* character of theories—affirming that they are not an *end in themselves*, but *media* and “organisms” whose efficacy and value is rigorously

dependent upon their agility, upon the absence of encumbrances and hindrances to their movements, upon their resemblance rather to lions and tigers than to hippopotami and mastodons. The favorite dictum of Plato: *ρεῖτερον ἡμῖν παντός* is no less applicable to scientific theories than to any other branch of human activity.

GIOVANNI VAILATI

PROLEGOMENA TO AN APOLOGY FOR PRAG- MATICISM.

COME on, my Reader, and let us construct a diagram to illustrate the general course of thought; I mean a System of diagrammatization by means of which any course of thought can be represented with exactitude.

"But why do that, when the thought itself is present to us?" Such, substantially, has been the interrogative objection raised by more than one or two superior intelligences, among whom I single out an eminent and glorious General.

Recluse that I am, I was not ready with the counter-question, which should have run, "General, you make use of maps during a campaign, I believe. But why should you do so, when the country they represent is right there?" Thereupon, had he replied that he found details in the maps that were so far from being "right there," that they were within the enemy's lines, I ought to have pressed the question, "Am I right, then, in understanding that, if you were thoroughly and perfectly familiar with the country, as, for example, if it lay just about the scenes of your childhood, no map of it would then be of the smallest use to you in laying out your detailed plans?" To that he could only have rejoined, "No, I do not say that, since I might probably desire the maps to stick pins into, so as to mark each anticipated day's change in the situations of the two armies." To that again, my sur-

rejoinder should have been, "Well, General, that precisely corresponds to the advantages of a diagram of the course of a discussion. Indeed, just there, where you have so clearly pointed it out, lies the advantage of diagrams in general. Namely, if I may try to state the matter after you, one can make exact experiments upon uniform diagrams; and when one does so, one must keep a bright lookout for unintended and unexpected changes thereby brought about in the relations of different significant parts of the diagram to one another. Such operations upon diagrams, whether external or imaginary, take the place of the experiments upon real things that one performs in chemical and physical research. Chemists have ere now, I need not say, described experimentation as the putting of questions to Nature. Just so, experiments upon diagrams are questions put to the Nature of the relations concerned." The General would here, may be, have suggested, (if I may emulate illustrious warriors in reviewing my encounters in afterthought,) that there is a good deal of difference between experiments like the chemist's, which are trials made upon the very substance whose behavior is in question, and experiments made upon diagrams, these latter having no physical connection with the things they represent. The proper response to that, and the only proper one, making a point that a novice in logic would be apt to miss, would be this: "You are entirely right in saying that the chemist experiments upon the very object of investigation, albeit, after the experiment is made, the particular sample he operated upon could very well be thrown away, as having no further interest. For it was not the particular sample that the chemist was investigating; it was the molecular *structure*. Now he was long ago in possession of overwhelming proof that all samples of the same molecular structure react chemically in exactly the same way; so that one sample

is all one with another. But the object of the chemist's research, that upon which he experiments, and to which the question he puts to Nature relates, is the Molecular Structure, which in all his samples has as complete an identity as it is in the nature of Molecular Structure ever to possess. Accordingly, he does, as you say, experiment upon the Very Object under investigation. But if you stop a moment to consider it, you will acknowledge, I think, that you slipped in implying that it is otherwise with experiments made upon diagrams. For what is there the Object of Investigation? It is the *form of a relation*. Now this Form of Relation is the very form of the relation between the two corresponding parts of the diagram. For example, let f_1 and f_2 be the two distances of the two foci of a lens from the lens. Then,

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{f_0}.$$

This equation is a diagram of the form of the relation between the two focal distances and the principal focal distance; and the conventions of algebra (and all diagrams, nay all pictures, depend upon conventions) in conjunction with the writing of the equation, establish a relation between the very *letters* f_1, f_2, f_0 , regardless of their significance, the form of which relation is the *Very Same* as the form of the relation between the three focal distances that these letters denote. This is a truth quite beyond dispute. Thus, this algebraic Diagram presents to our observation the very, identical object of mathematical research, that is, the Form of the harmonic mean, which the equation aids one to study. [But do not let me be understood as saying that a Form possesses, itself, Identity in the strict sense; that is, what the logicians, translating $\acute{\alpha}\rho\iota\theta\mu\acute{\omega}\tilde{\iota}$, call "numerical identity."]

Not only is it true that by experimentation upon some diagram an experimental proof can be obtained of every

necessary conclusion from any given Copulate of Premises, but, what is more, no "necessary" conclusion is any more apodictic than inductive reasoning becomes from the moment when experimentation can be multiplied *ad libitum* at no more cost than a summons before the imagination. I might furnish a regular proof of this, and am dissuaded from doing so now and here only by the exigency of space, the ineluctable length of the requisite explanations, and particularly by the present disposition of logicians to accept as sufficient F. A. Lange's persuasive and brilliant, albeit defective and in parts even erroneous, apology for it. Under these circumstances, I will content myself with a rapid sketch of my proof. First, an analysis of the essence of a sign, (stretching that word to its widest limits, as *anything which, being determined by an object, determines an interpretation to determination, through it, by the same object,*) leads to a proof that every sign is determined by its object, either first, by partaking in the characters of the object, when I call the sign an *Icon*; secondly, by being really and in its individual existence connected with the individual object, when I call the sign an *Index*; thirdly, by more or less approximate certainty that it will be interpreted as denoting the object, in consequence of a habit [which term I use as including a natural disposition], when I call the sign a *Symbol*.* I next examine into the different efficiencies and inefficiencies of these three kinds of signs in aiding the ascertainment of truth. A Symbol incorporates a habit, and is indispensable to the application of any *intellectual* habit, *at least*. Moreover, Symbols afford the means of thinking about thoughts in ways in which we could not otherwise think of them. They enable us, for example, to create Abstractions, without which we should lack

* In the original publication of this division, in 1867, the term "representamen" was employed in the sense of a sign in general, while "sign" was taken as a synonym of *index*, and an *Icon* was termed a "likeness."

a great engine of discovery. These enable us to count, they teach us that collections are individuals [individual = individual object], and in many respects they are the very warp of reason. But since symbols rest exclusively on habits already definitely formed but not furnishing any observation even of themselves, and since knowledge is habit, they do not enable us to add to our knowledge even so much as a necessary consequent, unless by means of a definite preformed habit. Indices, on the other hand, furnish positive assurance of the reality and the nearness of their Objects. But with the assurance there goes no insight into the nature of those Objects. The same Perceptible may, however, function doubly as a Sign. That footprint that Robinson Crusoe found in the sand, and which has been stamped in the granite of fame, was an Index to him that some creature was on his island, and at the same time, as a Symbol, called up the idea of a man. Each *Icon* partakes of some more or less overt character of its object. They, one and all, partake of the most overt character of all lies and deceptions, — their Overtness. Yet they have more to do with the living character of truth than have either Symbols or Indices. The Icon does not stand unequivocally for this or that existing thing, as the Index does. Its Object may be a pure fiction, as to its existence. Much less is its Object necessarily a thing of a sort habitually met with. But there is one assurance that the Icon does afford in the highest degree. Namely, that which is displayed before the mind's gaze, — the Form of the Icon, which is also its object, — must be *logically possible*. This division of Signs is only one of ten different divisions of Signs which I have found it necessary more especially to study. I do not say that they are all satisfactorily definite in my mind. They seem to be all trichotomies, which form an attribute to the essentially triadic nature of a Sign. I mean because

three things are concerned in the functioning of a Sign; the Sign itself, its Object, and its Interpretant. I cannot discuss all these divisions in this article; and it can well be believed that the whole nature of reasoning cannot be fully exposed from the consideration of one point of view among ten. That which we can learn from this division is of what sort a Sign must be to represent the sort of Object that reasoning is concerned with. Now reasoning has to make its conclusion manifest. Therefore, it must be chiefly concerned with forms, which are the chief objects of rational insight. Accordingly, Icons are specially requisite for reasoning. A Diagram is mainly an Icon, and an Icon of intelligible relations. It is true that what must be is not to be learned by simple inspection of anything. But when we talk of deductive reasoning being necessary, we do not mean, of course, that it is infallible. But precisely what we do mean is that the conclusion follows from the form of the relations set forth in the premiss. Now since a diagram, though it will ordinarily have Symbolide Features, as well as features approaching the nature of Indices, is nevertheless in the main an Icon of the forms of relations in the constitution of its Object, the appropriateness of it for the representation of necessary inference is easily seen. But since you may, perhaps, be puzzled to understand how an Icon can exhibit a necessity—a Must-be,—I will here give, as an example of its doing so, my proof that the single members of no collection or plural, are as many as are the collections it includes, each reckoned as a single object, or, in other words, that there can be no relation in which every collection composed of members of a given collection should (taken collectively as a single object,) stand to some member of the latter collection to which no other such included collection of the following proposition, namely: that, taking any collection or plural, whatsoever, be it finite or infinite, and

calling this the *given collection*; and considering all the collections, or plurals, each of which is composed of some of the individual members of the given collection (but including along with these *Nothing* which is to be here as a collection having no members at all; and also including the single members of the given collection, conceived as so many collections each of a single member), and calling these the *involved collections*; the proposition is that there is no possible relation in which each involved collection, (considered as a single object,) stands to a member of the given collection, without any other of the involved collections standing in the same relation to that same member of the given collection, so stands. This purely symbolic statement can be rendered much more perspicuous by the introduction of Indices, as follows. The proposition is that no matter what collection C may be, and no matter what relation R may be, there must be some collection, c' , composed exclusively of members of C , which does not stand in the relation R to any member, k , of C , unless some other collection, c'' , likewise composed of members of C , stands in the same relation R to the same k . The theorem is important in the doctrine of multitude, since it is the same as to say that any collection, no matter how great, is less multitudinous than the collection of possible collections composed exclusively of members of it; although formerly this was assumed to be false of some infinite collections. The demonstration begins by insisting that, if the proposition be false, there must be some definite relation of which it is false. Assume, then, that the letter R is an index of any one such relation you please. Next divide the members of C into four classes as follows:

Class I is to consist of all those members of C (if there be any such) to each of which no collection of members of C stands in the relation R .

Class II is to consist of all those members of C to

each of which one and only one collection of members of *C* stands in the relation *R*; and this class has two subclasses, as follows:

Sub-Class 1 is to consist of whatever members of Class II there may be each of which is contained in that one collection of members of *C* that is in the relation, *R*, to it.

Sub-Class 2 is to consist of whatever members of Class II there may be none of which is contained in that one collection of members of *C* that is in the relation *R* to it.

Class III is to consist of all those members of *C*, if there be any such, to each of which more than one collection of members of *C* are in the relation *R*.

This division is complete; but everybody would consider the easy diagrammatical proof that it is so as needless to the point of nonsense, implicitly relying on a Symbol in his memory which assures him that every Division of such construction is complete.

I ought already to have mentioned that, throughout the enunciation and demonstration of the proposition to be proved, the term "collection included in the given collection" is to be taken in a peculiar sense to be presently defined. It follows that there is one "possible collection" that is included in every other, that is, which excludes whatever any other excludes. Namely, this is the "possible collection" which includes only the Sphinxes, which is the same that includes only the Basilisks, and is identical with the "possible collection" of all the Centaurs, the unique and ubiquitous collection called "Nothing," which has no member at all. If you object to this use of the term "collection," you will please substitute for it, throughout the enunciation and the demonstration, any other designation of the same object. I prefix the adjective "pos-

sible," though I must confess it does not express my meaning, merely to indicate that I extend the term "collection" to Nothing, which, of course, has no existence. Were the suggested objection to be persisted in by those *soi-disant* reasoners who refuse to think at all about the object of this or that description, on the ground that it is "inconceivable," I should not stop to ask them how they could say that, when that involves thinking of it in the very same breath, but should simply say that for them it would be necessary to except collections consisting of single individuals. Some of these mighty intellects refuse to allow the use of any name to denote single individuals and also plural collections along with them; and for them the proposition ceases to be true of pairs. If they would not allow pairs to be denoted by any term that included all higher collections, the proposition would cease to be true of triplets and so on. In short, by restricting the meaning of "possible collection," the proposition may be rendered false of *small* collections. No general formal restriction can render it false of *greater* collections.

I shall now assume that you will permit me to use the term "possible collection" according to the following definition. A "possible collection" is an *ens rationis* of such a nature that the definite plural of any noun, or possible noun of definite signification, (as "the A's," "the B's," etc) denotes one, and only one, "possible collection" in any one perfectly definite state of the universe; and there is a certain relation between some "possible collections," expressed by saying that one "possible collection" *includes* another (or the same) "possible collection," and if, and only if, of two nouns one is universally and affirmatively predicable of the other in any one perfectly definite state of the universe, then the "possible collection" denoted by the definite plural of the former *includes* whatever "possible collection" is *included* by the "possible collection"

denoted by the definite plural of the latter, and of any two different "possible collections," one or other must *include* something not *included by* the other.

A diagram of the definition of "possible collection" being compared with a diagram embracing whatever members of subclasses 1 and 2 that it may, excluding all the rest, will now assure us that any such aggregate is a possible collection of members of the class C, no matter what individuals of Classes I and III be included or excluded in the aggregate along with those members of Class II, if any there be in the aggregate.

We shall select, then, a single possible collection of members of C to which we give the proper name *c*, and this possible collection shall be one which contains no individual of Subclass 1, but contains whatever individual there may be of Subclass 2. We then ask whether or not it is true that *c* stands in the relation *R* to a member of C to which no other possible collection of members of C stands in the same relation; or, to put this question into a more convenient shape, we ask, Is there any member of the Class C to which *c* and no other possible collection of members of C stands in the relation *R*? If there be such a member or members of C, let us give one of them the proper name T. Then T must belong to one of our four divisions of this class. That is,

either T belongs to Class I, (but that cannot be since by the definition of Class I, to no member of this class is any possible collection of members of C in the relation *R*);

or T belongs to Subclass 1, (but that cannot be, since by the definition of that subclass, every member of it is a member of the only possible collection of members of C that is *R* to it, which possible collection cannot be *c*, because *c* is only known to us by a description which forbids its containing any

- member of Subclass 1. Now it is c , and c only, that is in the relation R to T);
- or T belongs to Subclass 2, (but that cannot be, since by the definition of that subclass, no member of it is a member of the only possible collection of members of C that is R to it, which possible collection cannot be c , because the description by which alone c can be recognized makes it contain every member of Subclass 2. Now it is c only that is in the relation R to T);
- or T belongs to Class III (but this cannot be, since to every member of that class, by the definition of it, more than one collection of members of C stand in the relation R , while to T only one collection, namely, c , stands in that relation).

Thus, T belongs to none of the classes of members of C , and consequently is not a member of C . Consequently, there is no such member of C ; that is, no member of C to which c , and no other possible collection of members of C , stands in the relation R . But c is the proper name we were at liberty to give to whatever possible collection of members of C we pleased. Hence, there is no possible collection of members of C that stands in the relation R to a member of the class C to which no other possible collection of members of C stands in this relation R . But R is the name of *any* relation we please, and C is any class we please. It is, therefore, proved that no matter what class be chosen, or what relation be chosen, there will be some possible collection of members of that class (in the sense in which Nothing is such a collection) which does not stand in that relation to any member of that class to which no other such possible collection stands in the same relation.

When I was a boy, my logical bent caused me to take pleasure in tracing out upon a map of an imaginary laby-

rynth one path after another in hopes of finding my way to a central compartment. The operation we have just gone through is essentially of the same sort, and if we are to recognize the one as essentially performed by experimentation upon a diagram, so must we recognize that the other is performed. The demonstration just traced out brings home to us very strongly, also, the convenience of so constructing our diagram as to afford a clear view of the mode of connection of its parts, and of its composition at each stage of our operations upon it. Such convenience is obtained in the diagrams of algebra. In logic, however, the desirability of convenience in threading our way through complications is much less than in mathematics, while there is another desideratum which the mathematician as such does not feel. The mathematician wants to reach the conclusion, and his interest in the process is merely as a means to reach similar conclusions. The logician does not care what the result may be; his desire is to understand the nature of the process by which it is reached. The mathematician seeks the speediest and most abridged of secure methods; the logician wishes to make each smallest step of the process stand out distinctly, so that its nature may be understood. He wants his diagram to be, above all, as analytical as possible.

In view of this, I beg leave, Reader, as an Introduction to my defence of pragmatism, to bring before you a very simple system of diagrammatization of propositions which I term the System of Existential Graphs. For, by means of this, I shall be able almost immediately to deduce some important truths of logic, little understood hitherto, and closely connected with the truth of pragmatism; while discussions of other points of logical doctrine, which concern pragmatism but are not directly settled by this system, are nevertheless much facilitated by reference to it.

By a *graph*, (a word overworked of late years,) I, for

my part, following my friends Clifford and Sylvester, the introducers of the term, understand in general a diagram composed principally of spots and of lines connecting certain of the spots. But I trust it will be pardoned to me that, when I am discussing Existential Graphs, without having the least business with other Graphs, I often omit the differentiating adjective and refer to an Existential Graph as a Graph simply. But you will ask, and I am plainly bound to say, precisely what kind of a Sign an Existential Graph, or as I abbreviate that phrase here, a *Graph*, is. In order to answer this I must make reference to two different ways of dividing all Signs. It is no slight task, when one sets out from none too clear a notion of what a Sign is,—and you will, I am sure, Reader, have noticed that my definition of a Sign is not convincingly distinct,—to establish a single vividly distinct division of all Signs. The one division which I have already given has cost more labor than I should care to confess. But I certainly could not tell you what sort of a Sign an Existential Graph is, without reference to two other divisions of Signs. It is true that one of these involves none but the most superficial considerations, while the other, though a hundredfold more difficult, resting as it must for a clear comprehension of it upon the profoundest secrets of the structure of Signs, yet happens to be extremely familiar to every student of logic. But I must remember, Reader, that your conceptions may penetrate far deeper than mine; and it is to be devoutly hoped they may. Consequently, I ought to give such hints as I conveniently can, of my notions of the structure of Signs, even if they are not strictly needed to express my notions of Existential Graphs.

I have already noted that a Sign has an Object and an Interpretant, the latter being that which the Sign produces in the Quasi-mind that is the Interpreter by determining the latter to a feeling, to an exertion, or to a Sign, which

determination is the Interpretant. But it remains to point out that there are usually two Objects, and more than two Interpretants. Namely, we have to distinguish the Immediate Object, which is the Object as the Sign itself represents it, and whose Being is thus dependent upon the Representation of it in the Sign, from the Dynamical Object, which is the Reality which by some means contrives to determine the Sign to its Representation. In regard to the Interpretant we have equally to distinguish, in the first place, the Immediate Interpretant, which is the interpretant as it is revealed in the right understanding of the Sign itself, and is ordinarily called the *meaning* of the sign; while in the second place, we have to take note of the Dynamical Interpretant which is the actual effect which the Sign, as a Sign, really determines. Finally there is what I provisionally term the Final Interpretant, which refers to the manner in which the Sign tends to represent itself to be related to its Object. I confess that my own conception of this third interpretant is not yet quite free from mist. Of the ten divisions of signs which have seemed to me to call for my special study, six turn on the characters of an Interpretant and three on the characters of the Object. Thus the division into Icons, Indices, and Symbols depends upon the different possible relations of a Sign to its Dynamical Object. Only one division is concerned with the nature of the Sign itself, and this I now proceed to state.

A common mode of estimating the amount of matter in a MS. or printed book is to count the number of words.* There will ordinarily be about twenty *thes* on a page, and of course they count as twenty words. In another sense of the word "word," however, there is but one word "the" in the English language; and it is impossible that this word should lie visibly on a page or be heard in any voice,

* Dr. Edward Eggleston originated the method.

for the reason that it is not a Single thing or Single event. It does not exist; it only determines things that do exist. Such a definitely significant Form, I propose to term a *Type*. A Single event which happens once and whose identity is limited to that one happening or a Single object or thing which is in some single place at any one instant of time, such event or thing being significant only as occurring just when and where it does, such as this or that word on a single line of a single page of a single copy of a book, I will venture to call a *Token*. An indefinite significant character such as a tone of voice can neither be called a Type nor a Token. I propose to call such a Sign a *Tone*. In order that a Type may be used, it has to be embodied in a Token which shall be a sign of the Type, and thereby of the object the Type signifies. I propose to call such a Token of a Type an *Instance* of the Type. Thus, there may be twenty Instances of the Type "the" on a page. The term (Existential) *Graph* will be taken in the sense of a Type; and the act of embodying it in a *Graph-Instance* will be termed *scribing* the Graph (not the Instance), whether the Instance be written, drawn, or incised. A mere blank place is a Graph-Instance, and the Blank *per se* is a Graph; but I shall ask you to assume that it has the peculiarity that it cannot be abolished from any Area on which it is scribed, as long as that Area exists.

A familiar logical triplet is Term, Proposition, Argument. In order to make this a division of all signs, the first two members have to be much widened. By a *Seme*. I shall mean anything which serves for any purpose as a substitute for an object of which it is, in some sense, a representative or Sign. The logical Term, which is a class-name, is a Seme. Thus, the term "The mortality of man" is a Seme. By a *Pheme* I mean a Sign which is equivalent to a grammatical sentence, whether it be Interrogative, Imperative, or Assertory. In any case, such a

Sign is intended to have some sort of compulsive effect on the Interpreter of it. As the third member of the triplet, I sometimes use the word *Delome* (pronounce dee-loam, from *δήλωμα*), though *Argument* would answer well enough. It is a Sign which has the Form of tending to act upon the Interpreter through his own self-control, representing a process of change in thoughts or signs, as if to induce this change in the Interpreter.

A Graph is a PHEME, and in my use hitherto, at least, a Proposition. An Argument is represented by a series of Graphs.

The Immediate Object of all knowledge and all thought is, in the last analysis, the Percept. This doctrine in no wise conflicts with Pragmaticism, which holds that the Immediate Interpretant of all thought proper is Conduct. Nothing is more indispensable to a sound epistemology than a crystal-clear discrimination between the Object and the Interpretant of knowledge; very much as nothing is more indispensable to sound notions of geography than a crystal-clear discrimination between north latitude and south latitude; and the one discrimination is not more rudimentary than the other. That we are conscious of our Percepts is a theory that seems to me to be beyond dispute; but it is not a fact of Immediate Perception. A fact of Immediate Perception is not a Percept, nor any part of a Percept; a Percept is a Seme, while a fact of Immediate Perception or rather the Perceptual Judgment of which such fact is the Immediate Interpretant, is a PHEME that is the direct Dynamical Interpretant of the Percept, and of which the Percept is the Dynamical Object, and is with some considerable difficulty, (as the history of psychology shows,) distinguished from the Immediate Object, though the distinction is highly significant. But not to interrupt our train of thought, let us go on to note that while the Immediate Object of a Percept is excessively vague, yet

natural thought makes up for that lack, (as it almost amounts to,) as follows. A late Dynamical Interpretant of the whole complex of Percepts is the Seme of a Perceptual Universe that is represented in instinctive thought as determining the original Immediate Object of every Percept. Of course, I must be understood as talking not psychology, but the logic of mental operations. Subsequent Interpretants furnish new Semes of Universes resulting from various adjunctions to the Perceptual Universe. They are, however, all of them, Interpretants of Percepts.

Finally, and in particular, we get a Seme of that highest of all Universes which is regarded as the Object of every true Proposition, and which, if we name it all, we call by the somewhat misleading title of "The Truth."

That said, let us go back and ask this question: How is it that the Percept, which is a Seme, has for its direct Dynamical Interpretant the Perceptual Judgment, which is a PHEME? For that is not the usual way with Semes, certainly. All the examples that happen to occur to me at this moment of such action of Semes are instances of Percepts, though doubtless there are others. Since not all Percepts act with equal energy in this way, the instances may be none the less instructive for being Percepts. However, Reader, I beg you will think this matter out for yourself, and then you can see,—I wish I could,—whether your independently formed opinion does not fall in with mine. My opinion is that a pure perceptual Icon,—and many really *great* psychologists have evidently thought that Perception is a passing of images before the mind's eye, much as if one were walking through a picture-gallery,—could not have a PHEME for its direct Dynamical Interpretant. I desire, for more than one reason, to tell you *why* I think so, although that you should to-day appreciate my reasons seems to be out of the question. Still.

I wish you to understand me so far as to know that, mistaken though I be, I am not so sunk in intellectual night as to be dealing lightly with philosophic Truth when I aver that weighty reasons have moved me to the adoption of my opinion; and I am also anxious that it should be understood that those reasons have not been psychological at all, but are purely logical. My reason, then, briefly stated and abridged, is that it would be *illogical* for a pure Icon to have a PHEME for its Interpretant, and I hold it to be impossible for thought not subject to self-control, as a Perceptual Judgment manifestly is not, to be illogical. I dare say this reason may excite your derision or disgust, or both; and if it does, I think none the worse of your intelligence. You probably opine, in the first place, that there is no meaning in saying that thought which draws no Conclusion is illogical, and that, at any rate, there is no standard by which I can judge whether such thought is logical or not; and in the second place, you probably think that, if self-control has any essential and important relation to logic, which I guess you either deny or strongly doubt, it can only be that it is that which makes thought *logical*, or else which establishes the distinction between the logical and the illogical, and that in any event it has to be such as it is, and would be logical, or illogical, or both, or neither, whatever course it should take. But though an Interpretant is not necessarily a Conclusion, yet a Conclusion is necessarily an Interpretant. So that if an Interpretant is not subject to the rules of Conclusions there is nothing monstrous in my thinking it is subject to some generalization of such rules. For any evolution of thought, whether it leads to a Conclusion or not, there is a certain normal course, which is to be determined by considerations not in the least psychological, and which I wish to expound in my next article; and while I entirely agree, in opposition to distinguished logicians, that normality can be no

criterion for what I call rationalistic reasoning, such as alone is admissible in science, yet it is precisely the criterion of instinctive or common-sense reasoning, which, within its own field, is much more trustworthy than rationalistic reasoning. In my opinion, it is self-control which makes any other than the normal course of thought possible, just as nothing else makes any other than the normal course of action possible; and just as it is precisely that that gives room for an ought-to-be of conduct, I mean Morality, so it equally gives room for an ought-to-be of thought, which is Right Reason; and where there is no self-control, nothing but the normal is possible. If your reflections have led you to a different conclusion from mine, I can still hope that when you come to read my next article, in which I shall endeavor to show what the forms of thought are, in general and in some detail, you may yet find that I have not missed the truth.

But supposing that I am right, as I probably shall be in the opinions of *some* readers, how then is the Perceptual Judgment to be explained? In reply, I note that a Percept cannot be dismissed at will, even from memory. Much less can a person prevent himself from perceiving that which, as we say, stares him in the face. Moreover, the evidence is overwhelming that the perceiver is aware of this compulsion upon him; and if I cannot say for certain how this knowledge comes to him, it is not that I cannot conceive how it could come to him, but that, there being several ways in which this might happen, it is difficult to say which of those ways actually is followed. But that discussion belongs to psychology; and I will not enter upon it. Suffice it to say that the perceiver is aware of being compelled to perceive what he perceives. Now existence means precisely the exercise of compulsion. Consequently, whatever feature of the percept is brought into relief by some association and thus attains a logical position like

that of the observational premiss of an explaining Abduction,* the attribution of Existence to it in the Perceptual Judgment is virtually and in an extended sense, a logical Abductive Inference nearly approximating to necessary inference. But my next paper will throw a flood of light upon the logical affiliation of the Proposition and the PHEME generally, to coercion.

That conception of Aristotle which is embodied for us in the cognate origin of the terms *actuality* and *activity* is one of the most deeply illuminating products of Greek thinking. Activity implies a generalization of *effort*; and effort is a two-sided idea, effort and resistance being inseparable, and therefore the idea of Actuality has also a dyadic form.

No cognition and no Sign is absolutely precise, not even a Percept; and indefiniteness is of two kinds, indefiniteness as to what is the Object of the Sign, and indefiniteness as to its Interpretant, or indefiniteness in Breadth and in Depth. Indefiniteness in Breadth may be either Implicit or Explicit. What this means is best conveyed in an example. The word *donation* is indefinite as to who makes the gift, what he gives, and to whom he gives it. But it calls no attention, itself, to this indefiniteness. The word *gives* refers to the same sort of fact, but its meaning is such that that meaning is felt to be incomplete unless those items are, at least formally, specified; as they are in "Somebody gives something to some person (real or artificial)." An ordinary Proposition ingeniously contrives to convey novel information through Signs whose significance depends entirely on the interpreter's familiarity with them; and this it does by means of a "Predicate," i. e., a term explicitly indefinite in breadth,

* Abduction, in the sense I give the word, is any reasoning of a large class of which the provisional adoption of an explanatory hypothesis is the type. But it includes processes of thought which lead only to the suggestion of questions to be considered, and includes much besides.

and defining its breadth by means of "Subjects," or terms whose breadths are somewhat definite, but whose informative depth (i. e., all the depth except an essential superficiality) is indefinite, while conversely the depth of the Subjects is in a measure defined by the Predicate. A Predicate is either non-relative, or *a monad*, that is, is explicitly indefinite in one extensive respect, as is "black"; or it is a dyadic relative, or dyad, such as "kills," or it is a polyadic relative, such as "gives." These things must be diagrammatized in our system.

Something more needs to be added under the same head. You will observe that under the term "Subject" I include, not only the subject nominative, but also what the grammarians call the direct and the indirect object, together, in some cases, with nouns governed by prepositions. Yet there is a sense in which we can continue to say that a Proposition has but one Subject, for example, in the proposition, "Napoleon ceded Louisiana to the United States," we may regard as the Subject the ordered triplet, "Napoleon,—Louisiana,—the United States," and as the Predicate, "has for its first member, the agent, or party of the first part, for its second member the object, and for its third member the party of the second part of one and the same act of cession." The view that there are three subjects is, however, preferable for most purposes, in view of its being so much more analytical, as will soon appear.

All general, or definable, Words, whether in the sense of Types or of Tokens, are certainly Symbols. That is to say, they denote the objects that they do by virtue only of there being a habit that associates their signification with them. As to Proper Names, there might perhaps be a difference of opinion, especially if the Tokens are meant. But they should probably be regarded as Indices, since the actual connection (as we listen to talk,) of Instances

of the same typical words with the same Objects, alone causes them to be interpreted as denoting those Objects. Excepting, if necessary, propositions in which all the subjects are such signs as these, no proposition can be expressed without the use of Indices.* If, for example, a man remarks, "Why, it is raining!" it is only by some such *circumstances* as that he is now standing here looking out at a window as he speaks, which would serve as an Index (not, however, as a Symbol,) that he is speaking of this place at this time, whereby we can be assured that he cannot be speaking of the weather on the satellite of Proeyon, fifty centuries ago. Nor are Symbols and Indices together generally enough. The arrangement of the words in the sentence, for instance, must serve as *Icons*, in order that the sentence may be understood. The chief need for the Icons is in order to show the Forms of the synthesis of the elements of thought. For in precision of speech, Icons can represent nothing but Forms and Feelings. That is why Diagrams are indispensable in all Mathematics, from Vulgar Arithmetic up, and in Logic are almost so. For Reasoning, nay, Logic generally, hinges entirely on Forms. You, Reader, will not need to be told that a regularly stated Syllogism is a Diagram; and if you take at random a half dozen out of the hundred odd logicians who plume themselves upon not belonging to the sect of Formal Logic, and if from this latter sect you take another half dozen at random, you will find that in proportion as the former avoid diagrams, they utilize the syntactical Form of their sentences. No pure Icons represent anything but Forms; no pure Forms are represented by anything but Icons. As for Indices, their utility especially shines where other Signs fail. Extreme precision being desired in the description of a red color, should I call it vermillion, I may be criti-

* Strictly pure Symbols can signify only things familiar, and those only in so far as they are familiar.

cized on the ground that vermillion differently prepared has quite different hues, and thus I may be driven to the use of the color-wheel, when I shall have to Indicate four disks individually, or I may say in what proportions light of a given wave-length is to be mixed with white light to produce the color I mean. The wave-length being stated in fractions of a micron, or millionth of a meter, is referred through an Index to two lines on an individual bar in the Pavillon de Breteuil, at a given temperature and under a pressure measured against gravity at a certain station and (strictly) at a given date, while the mixture with white, after white has been fixed by an Index of an individual light, will require at least one new Index. But of superior importance in Logic is the use of Indices to denote Categories and Universes,* which are classes that, being enormously large, very promiscuous, and known but in small part, cannot be satisfactorily defined, and therefore can only be denoted by Indices. Such, to give but a single instance, is the collection of all things in the Physical Universe. If anybody, your little son for example, who is such an assiduous researcher, always asking, What is the Truth, (*Τί ἐστὶν ἀλήθεια*;) but like "jesting Pilate," will not always stay for an answer, should ask you what the Universe of things physical is, you may, if convenient, take him to the Rigi-Kulm, and about sunset, point out all that is to be seen of Mountains, Forests, Lakes, Castles, Towns, and then, as the stars come out, all there is to be seen in the heavens, and all that though not seen, is reasonably conjectured to be there; and then tell him, "Imagine that what is to be seen in a city back yard to grow to all you can see here, and then let this grow in the same proportion as many times as there are trees in sight from

* I use the term *Universe* in a sense which excludes many of the so-called "universes of discourse" of which Boole, De Morgan, and many subsequent logicians speak, but which, being perfectly definable, would in the present system be denoted by the aid of a graph.

here, and what you would finally have would be harder to find in the Universe than the finest needle in America's yearly crop of hay." But such methods are perfectly futile: Universes cannot be described.

Oh, I overhear what you are saying, O Reader: that a Universe and a Category are not at all the same thing; a Universe being a receptacle or class of Subjects, and a Category being a mode of Predication, or class of Predicates. I never said they were the same thing; but whether you describe the two correctly is a question for careful study.

Let us begin with the question of Univeres. It is rather a question of an advisable point of view than of the truth of a doctrine. A logical universe is, no doubt, a collection of *logical* subjects, but not necessarily of metaphysical Subjects, or "substances"; for it may be composed of characters, of elementary facts, etc. See my definition in Baldwin's Dictionary. Let us first try whether we may not assume that there is but one kind of Subjects which are either existing things or else quite fictitious. Let it be asserted that there is some married woman who will commit suicide in case her husband fails in business. Surely that is a very different proposition from the assertion that some married woman will commit suicide if all married men fail in business. Yet if nothing is real but existing things, then, since in the former proposition nothing whatever is said as to what the lady will or will not do if her husband does *not* fail in business, and since of a given married couple this can only be false if the fact is contrary to the assertion, it follows it can only be false if the husband *does* fail in business and if the wife then fails to commit suicide. But the proposition only says that there is *some* married couple of which the wife is of that temper. Consequently, there are only two ways in which the proposition can be false, namely, first, by there not

being any married couple, and secondly, by *every* married man failing in business while *no* married woman commits suicide. Consequently, all that is required to make the proposition true is that there should either be some married man who does not fail in business, or else some married woman who commits suicide. That is, the proposition amounts merely to asserting that there is a married woman who will commit suicide if *every* married man fails in business. The equivalence of these two propositions is the absurd result of admitting no reality but existence. If, however, we suppose that to say that a woman will suicide if her husband fails, means that every *possible* course of events would either be one in which the husband would not fail or one in which the wife would commit suicide, then, to make that false it will not be requisite for the husband actually to fail, but it will suffice that there are *possible* circumstances under which he would fail, while yet his wife would not commit suicide. Now you will observe that there is a great difference between the two following propositions:

1st, There is some *one* married woman who under all possible conditions would commit suicide or else her husband would not have failed.

2nd, Under all possible circumstances there is some married woman *or other* who would commit suicide, or else her husband would not have failed.

The former of these is what is really meant by saying that there is some married woman who would commit suicide if her husband were to fail, while the latter is what the denial of any possible circumstances except those that really take place logically leads to interpreting, (or virtually interpreting,) the Proposition as asserting.

In other places, I have given many other reasons for my firm belief that there are real possibilities. I also think, however, that, in addition to actuality and possi-

bility, a *third* mode of reality must be recognized in that which, as the gipsy fortune-tellers express it, is "sure to come true," or, as we may say, is *destined*,* although I do not mean to assert that this is affirmation rather than the negation of this Mode of Reality. I do not see by what confusion of thought anybody can persuade himself that he does not believe that to-morrow is destined to come. The point is that it is to-day really true that to-morrow the sun will rise; or that, even if it does not, the clocks or *something*, will go on. For if it be not real it can only be fiction: a Proposition is either True or False. But we are too apt to confound destiny with the impossibility of the opposite. I see no impossibility in the sudden stoppage of everything. In order to show the difference, I remind you that, "impossibility" is that which, for example, describes the mode of falsity of the idea that there should be a collection of objects so multitudinous that there would not be characters enough in the universe of characters to distinguish all those things from one another. Is there anything of that sort about the stoppage of all motion? There is, perhaps, a *law of nature* against it; but that is all. However, I will postpone the consideration of that point. Let us, at least, *provide* for such a mode of being in our system of diagrammatization, since it *may* turn out to be needed and, as I think, surely will.

I will proceed to explain why, although I am not prepared to deny that every proposition can be represented, and that I must say, for the most part very conveniently, under your view that the Universes are receptacles of the Subjects alone, I, nevertheless, cannot deem that mode of analyzing propositions to be satisfactory.

*I take it that anything may fairly be said to be *destined* which is sure to come about although there is no necessitating reason for it. Thus, a pair of dice, thrown often enough, will be sure to turn up sixes some time, although there is no necessity that they should. The probability that they will is 1: that is all. *Fate* is that special kind of *destiny* by which events are supposed to be brought about *under definite circumstances* which involve no necessitating cause for those occurrences.

And to begin with, I trust you will all agree with me that no analysis, whether in logic, in chemistry, or in any other science, is satisfactory, unless it be thorough, that is, unless it separates the compound into components each entirely homogeneous in itself, and therefore free from the smallest admixture of any of the others. It follows that in the Proposition, "Some Jew is shrewd," the Predicate is "Jew-that-is-shrewd," and the Subject is *Something*, while in the proposition "Every Christian is meek," the Predicate is "Either not Christian or else meek," while the Subject is *Anything*; unless, indeed, we find reason to prefer to say that this Proposition means, "It is false to say that a person is Christian of whom it is false to say that he is meek." In this last mode of analysis, when a Singular Subject is not in question (which case will be examined later,) the only Subject is *Something*. Either of these two modes of analysis quite clear the Subject from any Predicative ingredients; and at first sight, either seems quite favorable to the view that it is only the Subjects which belong to the Universes. Let us, however, consider the following two forms of propositions:

1. Any adept alchemist could produce a philosopher's stone of some kind or other,
2. There is one kind of philosopher's stone that any adept alchemist could produce.

We can express these on the principle that the Universes are receptacles of Subjects as follows:

1. The Interpreter having selected any individual he likes, and called it A, an object B can be found, such that, Either A would not be an adept alchemist, or B would be a philosopher's stone of some kind, and A could produce B.
2. Something B might be found, such that, no matter what the Interpreter might select and call A, B would be a philosopher's stone of some kind, while

either A would not be an adept alchemist, or else A could produce B.

In these forms there are two Universes, the one of individuals selected at pleasure by the interpreter of the proposition, the other of suitable objects.

I will now express the same two propositions on the principle that each Universe consists, not of Subjects, but the one of True assertions, the other of False, but each to the effect that there is something of a given description.

1. This is false: That something, P, is an adept alchemist and that this is false, that while something, S, is a philosopher's stone of some kind, P could produce S.
2. This is true: That something, S, is a philosopher's stone of some kind; and this is false, that something, P, is an adept alchemist while this is false, that P could produce S.

Here, the whole proposition is mostly made up of the truth or falsity of assertions that a thing of this or that description exists, the only conjunction being "and." That this method is highly analytic is manifest. Now since our whole intention is to produce a method for the perfect analysis of propositions, the superiority of this method over the other for our purpose is undeniable. Moreover, in order to illustrate how that other might lead to false logic, I will tack the predicate of No. 2, in its objectionable form upon the subject of No. 1 in the same form, and *vice versa*. I shall thus obtain two propositions which that method represents as being as simple as are Nos. 1 and 2. We shall see whether they are so. Here they are:

3. The Interpreter having designated any object to be called A, an object B may be found such that
 B is a philosopher's stone of some kind, while
 either A is not an adept alchemist or else A could
 produce B.

4. Something, B, may be found, such that, no matter what the interpreter may select, and call A,
 Either A would not be an adept alchemist, or
 B would be a philosopher's stone of some kind, and
 A could produce B.

Proposition 3 may be expressed in ordinary language thus: There is a kind of philosopher's stone, and if there be any adept alchemist, he could produce a philosopher's stone of some kind. That is, No. 3 differs from No. 1 only in adding that there is a kind of philosopher's stone. It differs from No. 2 in not saying that any two adepts could produce the same kind of stone, (nor that any adept could produce any existing kind,) while No. 2 asserts that some kind is both existent and could be made by every adept.

Proposition 4, in ordinary language, is: If there be (or were) an adept alchemist, there is (or would be) a kind of philosopher's stone that any adept could produce. This asserts the substance of No. 2, but only conditionally upon the existence of an adept; but it asserts, what No. 1 does not, that all adepts could produce some one kind of stone, and this is precisely the difference between No. 4 and No. 1.

To me it seems plain that the propositions 3 and 4 are both less simple than No. 1 and less simple than No. 2, each adding some thing to one of the pair first given and asserting the other conditionally. Yet the method of treating the Universes as receptacles for the metaphysical Subjects only, involves as a consequence the representation of 3 and 4 as quite on a par with 1 and 2.

It remains to show that the other method does not carry this error with it. It is the states of things affirmed or denied that are contained in the universes, then, the propositions become as follows:

3. This is true: that there is a philosopher's stone of some kind, S, and that it is false that there is an

adept, A, and that it is false that A could produce a philosopher's stone of some kind, S'. [Where it is neither asserted nor denied that S and S' are the same, thus distinguishing this from 2.]

4. This is false: That there is an adept, A, and that this is false: That there is a stone of a kind, S, and this is false: That there is an adept, A', and that this is false: That A' could produce a stone of the kind S. [Where again it is neither asserted nor denied that A and A' are identical, but the point is that this proposition holds even if they are not identical, thus distinguishing this from 1.]

These forms exhibit the greater complexity of Propositions 3 and 4, by showing that they really relate to *three* individuals each; that is to say, 3 to two possible different kinds of stone, as well as to an adept; and 4 to two possible different adepts, and to a kind of stone. Indeed, the two forms of statement of 3 and 4 on the other theory of the universes are absolutely identical in meaning with the following different forms on the same theory. Now it is, to say the least, a serious fault in a method of analysis that it can yield two analyses so different of one and the same compound.

3. An object, B, can be found, such that whatever object the interpreter may select and call A, an object, B', can thereupon be found such that B is an existing kind of philosopher's stone, and either A would not be an adept or else B' is a kind of philosopher's stone such as A could produce.
4. Whatever individual the Interpreter may choose to call A, an object, B, may be found, such that whatever individual the Interpreter may choose to call A', Either A is not an adept or B is an existing kind of philosopher's stone, and either A' is not an adept or else A' could produce a stone of the kind B.

But while my forms are perfectly analytic, the need of diagrams to exhibit their meaning to the eye (better than merely giving a separate line to every proposition said to be false,) is painfully obtrusive.*

I will now say a few words about what you have called Categories, but for which I prefer the designation Predicaments, and which you have explained as predicates of predicates. That wonderful operation of hypostatic abstraction by which we seem to create *entia rationis* that are, nevertheless, sometimes real, furnish us the means of turning predicates from being signs that we think or think *through*, into being subjects thought of. We thus think of the thought-sign itself, making it the object of another thought-sign. Thereupon, we can repeat the operation of hypostatic abstraction, and from these second intentions derive third intentions. Does this series proceed endlessly? I think not. What then are the characters of its different members? My thoughts on this subject are not yet harvested. I will only say that the subject concerns Logic, but that the divisions so obtained must not be confounded with the different Modes of Being; Actuality, Possibility, Destiny [or Freedom from Destiny]. On the contrary, the succession of Predicates of Predicates is different in the different Modes of Being. Meantime, it will be proper that in our system of diagrammatization we should provide for the division, whenever needed, of each of our three Universes of modes of reality into *Realms* for the different Predicaments.

All the various meanings of the word "Mind," Logical, Metaphysical, and Psychological, are apt to be confounded more or less, partly because considerable logical acumen is required to distinguish some of them, and because of

* In correcting the proofs, a good while after the above was written, I am obliged to confess that in some places the reasoning is erroneous; and a much simpler argument would have supported the same conclusion more justly; though some weight ought to be accorded to my argument here, on the whole

the lack of any machinery to support the thought in doing so, partly because they are so many, and partly because (owing to these causes,) they are all called by one word, "mind." In one of the narrowest and most concrete of its logical meanings, a Mind is that Seme of The Truth, whose determinations become Immediate Interpretants of all other Signs whose Dynamical Interpretants are dynamically connected. In our Diagram the same thing which represents The Truth must be regarded as in another way representing the Mind, and indeed, as being the Quasi-mind of all the Signs represented on the Diagram. For any set of Signs which are so connected that a complex of two of them can have one interpretant, must be Determinations of one Sign which is a *Quasi-mind*.

Thought is not necessarily connected with a brain. It appears in the work of bees, of crystals, and throughout the purely physical world; and one can no more deny that it is really there, than that the colors, the shapes, etc. of objects are really there. Consistently adhere to that unwarrantable denial, and you will be driven to some form of idealistic nominalism akin to Fichte's. Not only is thought in the organic world, but it develops there. But as there cannot be a General without Instances embodying it, so there cannot be thought without Signs. We must here give "Sign" a very wide sense, no doubt, but not too wide a sense to come within our definition. Admitting that connected Signs must have a Quasi-mind, it may further be declared that there can be no isolated sign. Moreover, signs require at least two Quasi-minds; a *Quasi-utterer* and a *Quasi-interpreter*; and although these two are at one (i. e. *are one mind*) in the sign itself, they must nevertheless be distinct. In the Sign they are, so to say, *welded*. Accordingly, it is not merely a fact of human Psychology, but a necessity of Logic, that every logical evolution of thought should be dialogic. You may say that all this is

loose talk; and I admit that, as it stands, it has a large infusion of arbitrariness. It might be filled out with argument so as to remove the greater part of this fault; but in the first place, such an expansion would require a volume,—and an uninviting one; and in the second place, what I have been saying is only to be applied to a slight determination of our system of diagrammatization, which it will only slightly affect; so that, should it be incorrect, the utmost *certain* effect will be a danger that our system *may* not represent every variety of non-human thought.

There now seems to remain no reason why we should not proceed forthwith to formulate and agree upon

THE CONVENTIONS

DETERMINING THE FORMS AND INTERPRETATIONS OF

Existential Graphs.

Convention the First: Of the Agency of the Scripture. We are to imagine that two parties* collaborate in composing a PHEME, and in operating upon this so as to develop a Delome. [Provision shall be made in these Conventions for expressing every kind of PHEME as a Graph;† and it is certain that the Method could be applied to aid the development and analysis of any kind of purposive thought. But hitherto no Graphs have been studied but such as are Propositions; so that, in the resulting uncertainty as to what modifications of the Conventions might be required for other applications, they have mostly been here stated as if they were only applicable to the expression of PHEMES and the working out of necessary conclusions.]

The two collaborating parties shall be called the *Graphist* and the *Interpreter*. The Graphist shall responsibly scribe each original Graph and each addition to it, with the proper indications of the Modality to be attached to

* They may be two bodies of persons, two persons, or two mental attitudes or states of one person.

† A Graph has already been defined on p. 503 *et seq.*

it the *relative Quality** of its position, and every particular of its dependence on and connections with other graphs. The Interpreter is to make such erasures and insertions of the Graph delivered to him by the Graphist as may accord with the "*General Permissions*" deducible from the Conventions and with his own purposes.

Convention the Second: Of the Matter of the Scripture, and the Modality of the Phemes expressed. The matter which the Graph-instances are to determine, and which thereby becomes the *Quasi-mind* in which the Graphist

* The traditional and ancient use of the term propositional *Quality* makes it an affair of the mode of expression solely. For "Socrates is mortal" and "Socrates is immortal" are equally Affirmative, "Socrates is not mortal" and "Socrates is not immortal" are equally Negative, provided "is not" translates *non est*. If, however, "is not" is in Latin *est non*, with no difference of meaning, the proposition is infinitated. Without anything but the merest verbiage to support the supposition that there is any corresponding distinction between different meanings of propositions, Kant insisted on raising the difference of expression to the dignity of a category. In *The Monist*, Vol. VII, p. 209, I gave some reason for considering a relative proposition to be affirmative or negative according as it does or does not unconditionally assert the existence of an indefinite subject. Although at the time of writing that, nine and a half years ago, I was constrained against my inclinations, to make that statement, yet I never heartily embraced that view, and dismissed it from my mind, until after I had drawn up the present statement of the Conventions of Existential Graphs, I found, quite to my surprise, that I had herein taken substantially the same view. That is to say, although I herein speak only of "relative" quality, calling the assertion of any proposition the Affirmation of it, and regarding the denial of it as an assertion *concerning* that proposition as subject, namely, that it is false; which is my distinction of Quality Relative to the proposition either itself Affirmed, or of which the falsity is affirmed, if the Relative Quality of it is Negative, yet since every Graph in itself either recognizes the existence of a familiar Singular subject or asserts something of an indefinite subject asserted to exist in some Universe, it follows that every relatively Affirmative Graph unconditionally asserts or recognizes the occurrence of some description of object in some Universe; while no relatively Negative Graph does this. The logic of a Limited Universe of Marks suggests a different view of Quality, but careful analysis shows that it is in no fundamental conflict with the above.

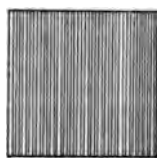
A question not altogether foreign to the subject of Quality is whether Quality and Modality are of the same general nature. In selecting a mode of representing Modality, which I have not done without much experimentation, I have finally resorted to one which commits itself as little as possible to any particular theory of the nature of Modality, although there are undeniable objections to such a course. If any particular analysis of Modality had appeared to me to be quite evident, I should have endeavored to exhibit it unequivocally. Meantime, my opinion is that the Universe is a Subject of every Proposition, and that any Modality shown by its indefiniteness to be Affirmative, such as Possibility and Intention, is a special determination of the Universe of The Truth. Something of this sort is seen in Negation. For if we say of a Man that he is not sinless, we represent the sinless as having a place only in an ideal universe which, or the part of which that contains the imagined sinless being, we then positively sever from the identity of the man in question.

and Interpreter are at one, being a Seme of *The Truth*, that is, of the widest Universe of Reality, and at the same time, a PHEME of all that is tacitly taken for granted between the Graphist and Interpreter, from the outset of their discussion, shall be a sheet, called the *PHEMIC SHEET*, upon which signs can be scribed, and from which any that are already scribed in any manner (even though they be

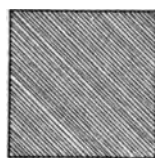
THE TINCTURES.
OF COLOR.



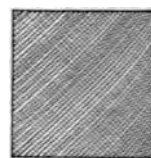
AZURE.



GULES.

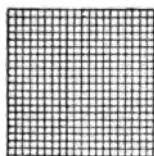


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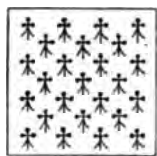


PURPURE.

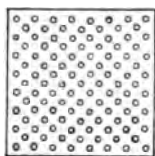
OF FUR.



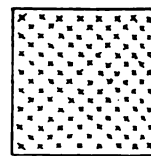
SABLE.



ERMINE.

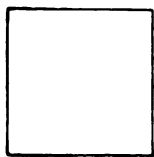


VAIR.

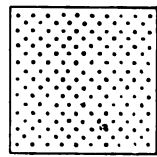


POTENT.

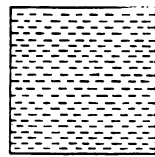
OF METAL.



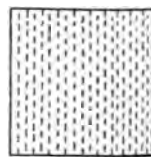
ARGENT.



OR.



FER.



PLOMB.

Fig. 1.

incised) *can* be erased. But certain parts of other sheets not having the significance of the PHEMIC sheet, but on which Graphs can be scribed and erased, shall be sometimes inserted in the PHEMIC sheet and exposed to view, as the Third Convention shall show. Every part of the exposed surface shall be tintured in one or another of

twelve tinctures. These are divided into three *classes* of four tinctures each, the class-characters being called *Modes of Tincture*, or severally, Color, Fur, and Metal. The tinctures of Colour are Azure, Gules, Vert, and Purple. Those of Fur are Sable, Ermine, Vair, and Potent. Those of Metal are Argent, Or, Fer, and Plomb. The Tinctures will in practice be represented as in Fig. 1.* The whole of any *continuous* part of the exposed surface in one tincture shall be termed a *Province*. The border of the sheet has one tincture all round; and we may imagine that it was chosen from among twelve, in agreement between the Graphist and the Interpreter at the outset. The province of the border may be called the *March*. Provinces adjacent to the March are to be regarded as overlying it; Provinces adjacent to those Provinces, but not to the March, are to be regarded as overlying the provinces adjacent to the March, and so on. We are to imagine that the Graphist always finds provinces where he needs them.

When any representation of a state of things consisting in the applicability of a given description to an individual or limited set of individuals otherwise indesignate is scribed, the Mode of Tincture of the province on which it is scribed shows whether the Mode of Being which is to be affirmatively or negatively attributed to the state of things described is to be that of Possibility, when Color will be used; or that of Intention, indicated by Fur; or that of Actuality shown by Metal. Special understandings may determine special tinctures to refer to special varieties of the three genera of Modality. Finally, the Mode of Tincture of the March may determine whether the Entire Graph is to be understood as Interrogative, Imperative, or Indicative.

*It is chiefly for the sake of these convenient and familiar modes of representation of Petrosancta, that a modification of heraldic tinctures has been adopted. Vair and Potent here receive less decorative and pictorial Symbols. Fer and Plomb are selected to fill out the quaternion of metals on account of their monosyllabic names.

Convention the Third: Of Areas enclosed within, but severed from, the Phemic Sheet. The Phemic Sheet is to be imagined as lying on the smoother of the two surfaces or sides of a *Leaf*, this side being called the *recto*, and to consist of so much of this side as is continuous with the March. Other parts of the *recto* may be *exposed* to view. Every Graph-instance on the Phemic Sheet is posited unconditionally (unless, according to an agreement between Graphist and Interpreter, the Tincture of its own Province or of the March should indicate a condition); and every Graph-instance on the *recto* is posited affirmatively and, in so far as it is indeterminate, indefinitely.

Should the Graphist desire to negative a Graph, he must scribe it on the *verso*, and then, before delivery to the Interpreter, must make an incision, called a *Cut*, through the Sheet all the way round the Graph-instance to be denied, and must then turn over the excised piece, so as to *expose* its rougher surface carrying the negatived Graph-instance. This reversal of the piece is to be conceived to be an inseparable part of the operation of making a *Cut*.* But if the Graph to be negatived includes a Cut, the twice negatived Graph within that Cut must be scribed on the *recto*, and so forth. The part of the exposed surface that is continuous with the part just outside the Cut is called the *Place of the Cut*. A Cut is neither a Graph nor a Graph-instance; but the Cut together with all that it encloses exposed is termed an *Enclosure*, and is conceived to be an Instance of a Graph *scribed* on the Place of the Cut, which is also termed the *Place of the Enclosure*. The surface within the Cut, continuous with the parts just within it, is termed the *Area* of the Cut and of the Enclosure; and the part of the *recto* continuous with the

*I am tempted to say that it is the reversal alone that effects the denial, the Cut merely cutting off the Graph within from assertion concerning the Universe to which the Phemic Sheet refers. But that is not the only possible view, and it would be rash to adopt it definitely, as yet.

March, (i. e., the Phemic Sheet,) is likewise termed an *Area*, namely the Area of the Border. The Copulate of all that is scribed on any one Area, including the Graphs of which the Enclosures whose Place is this Area are Instances, is called the *Entire Graph* of that Area; and any part of the Entire Graph, whether graphically connected with or disconnected from the other parts, provided it might be the Entire Graph of the Sheet, is termed a Partial Graph of the Area.

There may be any number of Cuts, one within another, the Area of one being the Place of the next, and since the Area of each is on the side of the leaf opposite to its Place, it follows that *recto* Areas may be *exposed* which are not parts of the Phemic Sheet. Every Graph-instance on a *recto* Area is affirmatively posited, but is posited conditionally upon whatever may be signified by the Graph on the Place of the Cut of which this Area is the Area. [It follows that Graphs on Areas of different Enclosures on a *verso* Place are only alternatively affirmed, and that while only the Entire Graph of the Area of an Enclosure on a *recto* Place is denied, but not its different Partial Graphs, except alternatively, the Entire Graphs of Areas of different Enclosures on one *recto* Place are copulatively denied.]

Every Graph-instance must lie upon one Area,* although an Enclosure may be a part of it. Graph-instances on different Areas are not to be considered as, nor by any permissible latitude of speech to be called, Parts of one Graph-instance, nor Instances of Parts of one Graph; for it is only Graph-instances on one Area that are called Parts of one Graph-instance, and that only of a Graph-instance

* For, of course, the Graph-instance must be on one sheet; and if part were on the *recto*, and part on the *verso*, it would not be on one continuous sheet. On the other hand, a Graph-instance can perfectly well extend from one Province to another, and even from one *Realm* (or space having one Mode of Tincture) to another. Thus, the Spot, "—is in the relation—to—," may, if the relation is that of an existent object to its purpose, have the first Peg on Metal, the second on Color, and the third on Fur.

on that same Area; for though the Entire Graph on the Area of an enclosure is termed the *Graph of the Enclosure*, it is no Part of the Enclosure and is connected with it only through a denial.

Convention the Fourth: concerning Signs of Individuals and of Individual Identity. A single dot, not too minute, or single congeries of contiguous pretty large dots, whether in the form of a line or surface, when placed on any exposed Area, will refer to a single member of the Universe to which the Tincture of that Area refers, but will not thereby be made to refer determinately to any one. But do not forget that separate dots, or separate aggregates of dots, will not necessarily denote different Objects.

By a *rheme*, or *predicate*, will here be meant a blank form of proposition which might have resulted by striking out certain parts of a proposition, and leaving a *blank* in the place of each, the parts stricken out being such that if each blank were filled with a proper name, a proposition (however nonsensical) would thereby be recomposed. An ordinary predicate of which no analysis is intended to be represented will usually be *written* in abbreviated form, but having a particular point on the periphery of the written form appropriated to each of the blanks that might be filled with a proper name. Such written form with the appropriated points shall be termed a *Spot*; and each appropriated point of its periphery shall be called a *Peg* of the Spot. If a heavy dot is placed at each Peg, the Spot will become a Graph expressing a proposition in which every blank is filled by a word (or concept) denoting an indefinite individual object, "something."

A heavy line shall be considered as a continuum of contiguous dots; and since contiguous dots denote a single individual, such a line without any point of branching will signify the identity of the individuals denoted by its extremities, and the type of such unbranching line shall

be the Graph of Identity, any instance of which (on one area, as every Graph-instance must be,) shall be called a *Line of Identity*. The type of a three-way point of such a line (Fig. 2) shall be the *Graph of Teridentity*; and it shall be considered as composed of three contiguous Pegs of a Spot of Identity. An extremity of a Line of Identity not abutting upon another such Line in another area shall be called a *Loose End*. A heavy line, whether confined to one area or not (and therefore not generally being a Graph-instance,) of which two extremities abut upon pegs of spots shall be called a *Ligature*. Two lines cannot abut upon the same peg other than a point of teridentity. [The purpose of this rule is to force the recognition of the demonstrable logical truth that the concept of teridentity is not mere identity. It is identity *and* identity, but this

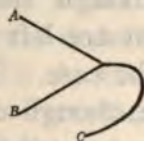


Fig. 2.



Fig. 3.

“and” is a distinct concept, and is precisely that of teridentity.] A Ligature crossing a Cut is to be interpreted as unchanged in meaning by erasing the part that crosses to the Cut and attaching to the two Loose Ends so produced two Instances of a Proper Name nowhere else used; such a Proper name (for which a capital letter will serve,) being termed a *Selective*. In the interpretation of Selectives it is often necessary to observe the rule which holds throughout the System, that the Interpretation of Existential Graphs must be *endoporeutic*, that is, the application of a Graph on the Area of a Cut will depend on the predetermination of the application of that which is on the Plate of the Cut.

In order to avoid the intersection of Lines of Identity,

either a Selective may be employed, or a *Bridge*, which is imagined to be a bit of paper ribbon, but will in practice be pictured as in Fig. 3.

Convention the Fifth: Of the Connections of Graph-Instances. Two partial Graph-Instances are said to be *individually and directly connected*, if, and only if, in the Entire Graph, one individually is, either unconditionally or under some condition, and whether affirmatively or negatively, made a Subject of both. Two Graph-Instances connected by a ligature are explicitly and definitely individually and directly connected. Two Graph-Instances in the same Province are thereby explicitly, although indefinitely, individually and directly connected, since both, or one and the negative of the other, or the negative of both, are asserted to be true or false together, that is, under the same circumstances, although these circumstances are not formally defined, but are left to be interpreted according to the nature of the case. Two Graph-instances not in the same Province, though on the same Mode of Tincture are only in so far connected that both are in the same Universe. Two Graph-Instances in different Modes of Tincture are only in so far connected that both, or one and the negative of the other, or the negative of both, are posited as appertaining to the Truth. They cannot be said to have any individual and direct connection. Two Graph-instances that are not individually connected within the innermost Cut which contains them both cannot be so connected at all; and every ligature connecting them is meaningless and may be made or broken.

Relations which do not imply the occurrence in their several universes of all their correlates must not be expressed by Spots or single Graphs,* but all such relations can be expressed in the System.

* It is permissible to have such spots as "possesses the character," "is in the real relation to," but it is not permissible to have such a spot as "can prevent the existence of."

I will now proceed to give a few examples of Existential Graphs in order to illustrate the method of interpretation, and also the *Permissions of Illative Transformation* of them.

If you carefully examine the above conventions, you will find that they are simply the development, and excepting in their insignificant details, the inevitable result of the development of the one convention that if any Graph, A, asserts one state of things to be real and if another graph, B, asserts the same of another state of things, then AB, which results from setting both A and B upon the sheet, shall assert that both states of things are real. This was not the case with my first system of Graphs, described in Vol. VII of *The Monist*, which I now call *Entitative Graphs*. But I was forced to this principle by a series of considerations which ultimately arrayed themselves into an exact logical deduction of all the features of Existential Graphs which do not involve the Tinctures. I have no room for this here; but I state some of the points arrived at somewhat in the order in which they first presented themselves.

In the first place, the most perfectly analytical system of representing propositions must enable us to separate illative transformations into indecomposable parts. Hence, an illative transformation from any proposition, A, to any other, B, must in such a system consist in first transforming A into AB, followed by the transformation of AB into B. For an omission and an insertion appear to be indecomposable transformations and the only indecomposable transformations. That is, if A can be transformed by insertion into AB, and AB by omission in B, the transformation of A into B can be decomposed into an insertion and an omission. Accordingly, since logic has primarily in view argument, and since the conclusiveness of an argument can never be weakened by adding to the premisses

nor by subtracting from the conclusion, I thought I ought to take the general form of argument as the basal form of composition of signs in my diagrammatization; and this necessarily took the form of a "scroll," that is (See Figs. 4, 5, 6) a curved line without contrary flexure and returning into itself after once crossing itself, and thus forming an outer and an inner "close." I shall call the outer boundary the *Wall*; and the inner, the *Fence*. In the outer I scribed the Antecedent, in the inner the Consequent, of a Conditional Proposition *de inesse*. The scroll was not taken for this purpose at hap-hazard, but was the result of experiments and reasonings by which I was brought to see that it afforded the most faithful Diagram of such a Proposition. This form once obtained, the logically inevitable

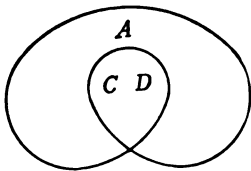


Fig. 4.

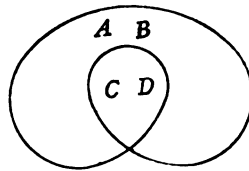


Fig. 5.

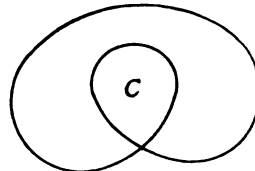


Fig. 6.

development brought me speedily to the System of Existential Graphs. Namely, the idea of the scroll was that Fig. 4, for example, should assert that if A be true (under the actual circumstances), then C and D are both true. This justifies Fig. 5, that if both A and B are true, then both C and D are true, no matter what B may assert, any insertion being permitted in the outer close, and any omission from the inner close. By applying the former clause of this rule to Fig. 6, we see that this scroll with the outer close void, justifies the assertion that if no matter what be true, C is in any case true; so that the two walls of the scroll, when nothing is between them, fall together, collapse, disappear, and leave only the contents of the inner close standing, asserted, in the open field. Suppos-

ing, then, that the contents of the inner scroll had been CD, these would have been left standing, both asserted; and we thus return to the principle that writing assertions together on the open sheet asserts them all. Now, Reader, if you will just take pencil and paper and scribe the scroll expressing that if A be true, then it is true that if B be true C and D are true, and compare this with Fig. 5, which amounts to the same thing in meaning, you will see that scroll walls with a void between them collapse even when they belong to different scrolls; and you will further see that a scroll is really nothing but one oval within another. Since a Conditional *de inesse* (unlike other conditionals,) only asserts that either the antecedent is false or the consequent is true, it all but follows that if

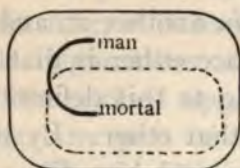


Fig. 7.



Fig. 8.

the latter alternative be suppressed by scribing nothing but the antecedent, which may be any proposition, in an oval, that antecedent is thereby denied. The use of a heavy line as a juncture signifying identity is inevitable; and since Fig. 7 must mean that if anything is a man, it is mortal, it will follow that Fig. 8 must mean "Something is a man."

The first permission of illative transformation is now evident as follows:

First Permission, called "The Rule of Deletion and Insertion." Any Graph-Instance can be deleted from any recto Area, (including the severing of any Line of Identity,) and any Graph-instance can be inserted on any verso Area, (including as a Graph-instance the juncture of any two Lines of Identity or Points of Teridentity.)

The justice of the following will be seen instantly by students of any form of Logical Algebra, and with very little difficulty by others:

Second Permission, called "The Rule of Iteration and Deiteration." Any Graph scribed on any Area may be Iterated in or (if already Iterated,) may be Deiterated by a deletion from that Area or from any other Area included within that. This involves the Permission to distort a line of Identity, at will.

To *iterate* a Graph means to scribe it again, while joining by Ligatures every Peg of the new Instance to the corresponding Peg of the Original Instance. To *deiterate* a Graph is to erase a second Instance of it, of which each Peg is joined by a Ligature to a first Instance of it. One Area is said to be *included within* another if, and only if, it is the Area of a Cut whose Place either is that Area or else, is an Area which, according to this definition, must be regarded as *included within* that other. By this Permission, Fig. 9 may be transformed into Fig. 10, and thence, by Permission No. 1, into Fig. 11.

We now come to the Third Permission, which I shall state in a form which is valid, sufficient for its purpose, and convenient in practice, but which cannot be assumed as an undeduced Permission, for the reason that it allows us to regard the Inner Scroll, after the Scroll is removed, as being a part of the Area on which the Scroll lies. Now this is not strictly either an Insertion or a Deletion; and a perfectly analytical System of Permissions should permit only the indecomposable operations of Insertion and Deletion of Graphs that are simple in expression. The more scientific way would be to substitute for the Second and Third Permissions the following Permission:

If an Area, Υ , and an Area, Ω , be related in any of these four ways, viz., (1) If Υ and Ω are the same Area; (2) If Ω is the Area of an Enclosure whose Place is Υ ; (3) If Ω is

the Area of an Enclosure whose Place is the Area of a second Enclosure whose Place is Υ ; or (4) If Ω is the Place of an Enclosure whose Area is vacant except that it is the Place of an Enclosure whose Area is Υ , and except that it may contain ligatures, identifying Pegs in Ω with Pegs in Υ ; then, if Ω be a recto area, any simple Graph already scribed upon Υ may be iterated upon Ω ; while if Ω be a verso Area, any simple Graph already scribed upon Υ and iterated upon Ω may be deiterated by being deleted or abolished from Ω .

These two Rules (of Deletion and Insertion, and of Iteration and Deiteration) are substantially all the undeduced Permissions needed; the others being either Consequences or Explanations of these. Only, in order that this may be true, it is necessary to assume that all indemonstrable implications of the Blank have from the beginning been scribed upon distant parts of the Phemic Sheet, upon any part of which they may, therefore, be iterated at will. I will give no list of these implications, since it could serve no other purpose than that of warning beginners that necessary propositions not included therein were deducible from the other permissions. I will simply notice two principles the neglect of which might lead to difficulties. One of these is that it is physically impossible to delete or otherwise get rid of a Blank in any Area that contains a Blank, whether alone or along with other Graph-Instances. We may, however, assume that there is one Graph, and only one, an Instance of which entirely fills up an Area, without any Blank. The other principle is that, since a Dot merely asserts that some individual object exists, and is thus one of the implications of the Blank, it may be inserted in any Area; and since the Dot will signify the same thing whatever its size, it may be regarded as an Enclosure whose Area is filled with an Instance of that sole Graph that excludes the Blank. The

Dot, then, denies that Graph, which may, therefore, be understood as the absurd Graph, and its signification may be formulated as "Whatever you please is true." The absurd Graph may also take the form of an Enclosure with its Area entirely Blank, or enclosing only some Instance of a Graph implied in the Blank. These two principles will enable the Graphist to thread his way through some Transformations which might otherwise appear paradoxical and absurd.

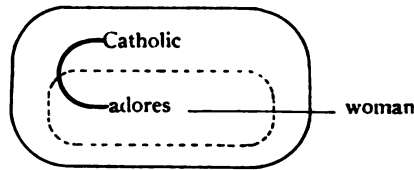


Fig. 9.

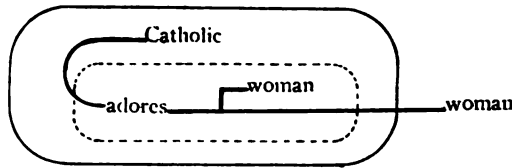


Fig. 10.

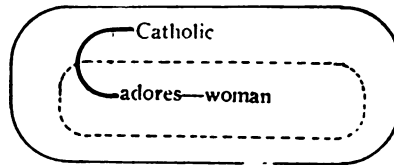


Fig. 11.

Third Permission; called "The Rule of the Double Cut." Two Cuts one within another, with nothing between them, unless it be Ligatures passing from outside the outer Cut to inside the inner one, may be made or abolished on any Area.

Let us now consider the Interpretation of such Ligatures. For that purpose, I first note that the Entire Graph of any *recto* Area is a wholly particular and affirmative

Proposition or Copulation of such Propositions. By "wholly particular," I mean, having for every Subject an indesignate individual. The Entire Graph of any *verso* Area is a wholly universal negative proposition or a disjunction of such propositions.

The first time one hears a Proper Name pronounced, it is but a name, predicated, as one usually gathers, of an existent, or at least historically existent, individual object, of which, or of whom, one almost always gathers some additional information. The next time one hears the name, it is by so much the more definite; and almost every time one hears the name, one gains in familiarity with the object. A Selective is a Proper Name met with by the Interpreter for the first time. But it always occurs twice, and usually on different areas. Now the Interpretation, by Convention No. 3, is to be Endoporeutic, so that it is the outermost occurrence of the Name that is the earliest.

Let us now analyze the interpretation of a Ligature passing through a Cut. Take, for example, the Graph of Fig. 12. The partial Graph on the Place of the Cut

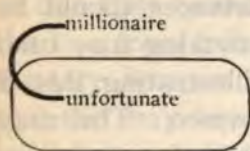


Fig. 12.

asserts that there exists an individual denoted by the extremity of the line of identity on the Cut, which is a millionaire. Call that individual C. Then, since contiguous dots denote the same individual objects, the extremity of

the line of identity on the Area of the cut is also C, and the Partial Graph on that Area, asserts that, let the Interpreter choose whatever individual he will, that individual is either not C, or else is not unfortunate. Thus, the Entire Graph asserts that there exists a millionaire who is not unfortunate. Furthermore, the Enclosure lying in the same Argent Province as the "millionaire," it is asserted that this individual's being a millionaire is *connected* with his not being unfortunate. This example

shows that the Graphist is permitted to extend any Line of Identity on a recto Area so as to carry an end of it to any Cut in that area. Let us next interpret Fig. 13. It

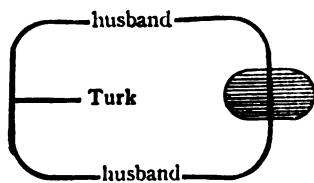


Fig. 13

obviously asserts that there exists a Turk who is at once the husband of an Individual denoted by a point on the Cut, which individual we may name U, and is the husband of an Individual, whom we may name V,

denoted by another point on the Cut. And the Graph on the Area of the cut, declares that whatever Individual the Interpreter may select either is not, and cannot be, U or is not and cannot be V. Thus, the Entire Graph asserts that there is an existent Turk who is husband of two existent persons; and the "husband," the "Turk" and the enclosure, all being in the same Argent province, although the *Area* of the Enclosure is on color, and thus denies the *possibility* of the identity of U and V, all four predications are true *together*, that is, are true under the same circumstances, which circumstances should be defined by a special convention when anything may turn upon what they are. For the sake of illustrating this, I shall now scribe Fig. 14 all in one province. This may

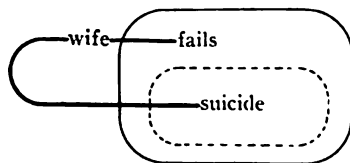


Fig. 14.

be read, "There is some married woman who will commit suicide in case her husband fails in business." This evidently goes far beyond saying that if every married man

fails in business some married woman will commit suicide. Yet note that since the Graph is on Metal it asserts a conditional proposition *de inesse* and only means that there is a married woman whose husband does not fail or else she commits suicide. That, at least, is all it will seem to

mean if we fail to take account of the fact, that being all in one Province, it is said that her suicide is *connected* with his failure. Neglecting that, the proposition only denies that every married man fails, while no married woman commits suicide. The logical principle is that to say that there is some one individual of which one or other of two predicates is true is no more than to say that there either is some individual of which one is true or else there is some individual of which the other is true. Or, to state the matter as an illative permission of the System of Existential Graphs,

Fourth Permission. If the smallest Cut which wholly contains a Ligature connecting two Graphs in different Provinces has its Area on the side of the Leaf opposite to that of the Area of the smallest Cut that contains those two Graphs, then such Ligature may be made or broken at pleasure, as far as these two Graphs are concerned.

Another somewhat curious problem concerning ligatures is to say by what principle it is true, as it evidently is true that the passage of ligatures from without the outer of two Cuts to within the inner of them will not prevent the two from collapsing in case there is no other Graph instance between them. A little study suffices to show that this may depend upon the ligatures' being replaceable by Selectives where they cross the Cuts, and that a Selective is always, at its first occurrence, a new predicate. For it is a principle of Logic that in introducing a new predicate one has a right to assert what one likes concerning it, without any restriction, as long as one implies no assertion concerning anything else. I will leave it to you, Reader, to find out how this principle accounts for the collapse of the two Cuts. Another solution of this problem, not depending on the superfluous device of Selectives is afforded by the second enunciation of the Rule of Iteration and Deiteration; since this permits the Graph of the Inner

Close to be at once iterated on the Phemic Sheet. One may choose between these two methods of solution.

The System of Existential Graphs which I have now sufficiently described,—or, at any rate, have described as well as I know how, leaving the further perfection of it to others,—greatly facilitates the solution of problems of Logic, as will be seen in the sequel, not by any mysterious properties, but simply by substituting for the symbols in which such problems present themselves, concrete visual figures concerning which we have merely to say whether

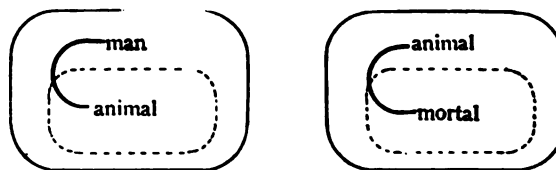


Fig. 15.

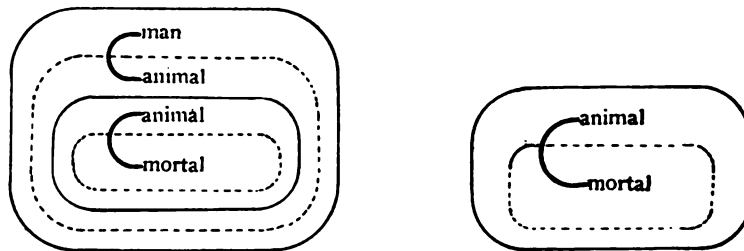


Fig. 16.

or not they admit certain describable relations of their parts. Diagrammatic reasoning is the only really fertile reasoning. If logicians would only embrace this method, we should no longer see attempts to base their science on the fragile foundations of metaphysics or a psychology not based on logical theory; and there would soon be such an advance in logic that every science would feel the benefit of it.

This System may, of course, be applied to the analysis of reasonings. Thus, to separate the syllogistic illation,

"Any man would be an animal, and any animal would be mortal; therefore, any man would be mortal," the Premises are first scribed as in Fig. 15. Then by the rule of Iteration, a first illative transformation gives Fig. 16. Next, by the permission to erase from a recto Area, a

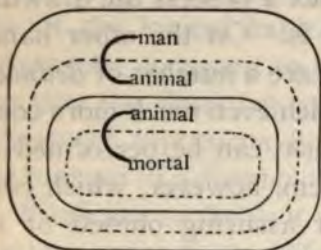


Fig. 17.

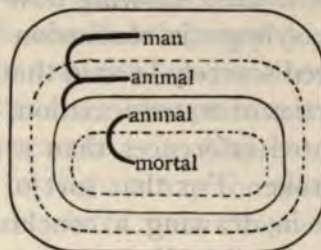


Fig. 18.

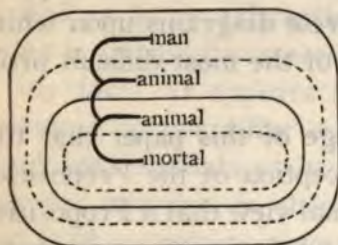


Fig. 19.

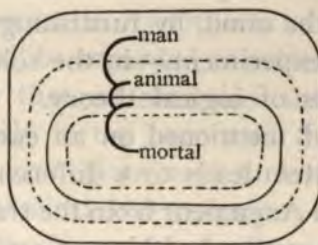


Fig. 20.

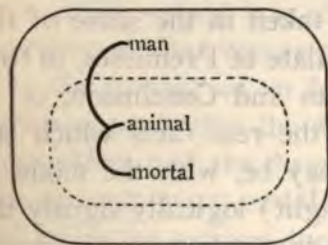


Fig. 21.

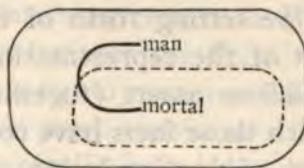


Fig. 22.

second step gives Fig. 17. Then, by the permission to deform a line of Identity on a recto Area, a third step gives Fig. 18. Next, by the permission to insert in a verso Area, a fourth step gives Fig. 19. Next, by Deiteration, a fifth step gives Fig. 20. Next, by the collapse of

two Cuts, a sixth step gives Fig. 21; and finally, by omission from a recto Area, a seventh step gives the conclusion Fig. 22. The analysis might have been carried a little further, by means of the Rule of Iteration and Deiteration, so as to increase the number of distinct inferential steps to nine, showing how complex a process the drawing of a syllogistic conclusion really is. On the other hand, it need scarcely be said that there are a number of *deduced* liberties of transformation, by which even much more complicated inferences than a syllogism can be performed at a stroke. For that sort of problem, however, which consists in drawing a conclusion or assuring oneself of its correctness, this System is not particularly adapted. Its true utility is in the assistance it renders,—the support to the mind, by furnishing concrete diagrams upon which to experiment,—in the solution of the most difficult problems of logical theory.

I mentioned on an early page of this paper that this System leads to a different conception of the Proposition and Argument from the traditional view that a Proposition is composed of Names, and that an Argument is composed of Propositions. It is a matter of insignificant detail whether the term Argument be taken in the sense of the Middle Term, in that of the Copulate of Premisses, in that of the setting forth of Premisses and Conclusion, or in that of the representation that the real facts which the premisses assert (together, it may be, with the mode in which those facts have come to light) logically signify the truth of the Conclusion. In any case, when an Argument is brought before us, there is brought to our notice (what appears so clearly in the Illative Transformations of Graphs) a process whereby the Premisses bring forth the Conclusion, not informing the Interpreter of its Truth, but appealing to him to assent thereto. This Process of Transformation, which is evidently the kernel of the mat-

ter, is no more built out of Propositions than a motion is built out of positions. The logical relation of the Conclusion to the Premisses might be asserted; but that would not be an Argument, which is essentially intended to be understood as representing what it represents only in virtue of the logical habit which would bring any logical Interpreter to assent to it. We may express this by saying that the Final (or quasi-intended) Interpretant of an Argument represents it as representing its Object after the manner of a Symbol. In an analogous way the relation of Predicate to Subject which is *stated* in a Proposition might be merely described in a Term. But the essence of the Proposition is that it intends, as it were, to be regarded as in an existential relation to its Object, as an Index is, so that its assertion shall be regarded as evidence of the fact. It appears to me that an assertion and a command do not differ essentially in the nature of their Final Interpretants as in their Immediate, and so far as they are effective, in their Dynamical Interpretants; but that is of secondary interest. The Name, or any Seme, is merely a substitute for its Object in one or another capacity in which respect it is all one with the Object. Its Final Interpretant thus represents it as representing its Object after the manner of an Icon, by mere agreement in idea. It thus appears that the difference between the Term, the Proposition, and the Argument, is by no means a difference of complexity, and does not so much consist in structure as in the services they are severally intended to perform.

For that reason, the ways in which Terms and Arguments can be compounded cannot differ greatly from the ways in which Propositions can be compounded. A mystery, or paradox, has always overhung the question of the Composition of Concepts. Namely, if two concepts, A and B, are to be compounded, their composition would

seem to be necessarily a third ingredient Concept, C, and the same difficulty will arise as to the Composition of A and C. But the Method of Existential Graphs solves this riddle instantly by showing that, as far as propositions go, and it must evidently be the same with Terms and Arguments, there is but one general way in which their Composition can possibly take place; namely, each component must be indeterminate in some respect or another; and in their composition each determines the other. On the *recto* this is obvious: "Some man is rich" is composed of "Something is a man" and "something is rich," and the two somethings merely explain each other's vagueness in a measure. Two simultaneous independent assertions are still connected in the same manner; for each is in itself vague as to the Universe or the "Province" in which its truth lies, and the two somewhat define each other in this respect. The composition of a Conditional Proposition is to be explained in the same way. The Antecedent is a Sign which is Indefinite as to its Interpretant; the Consequent is a Sign which is Indefinite as to its Object. They supply each the other's lack. Of course, the explanation of the structure of the Conditional gives the explanation of negation; for the negative is simply that from whose Truth it would be true to say that anything you please would follow *de inesse*.

In my next paper, the utility of this diagrammatization of thought in the discussion of the truth of Pragmatism shall be made to appear.

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MILFORD, PA.

PRAGMATISM, OLD AND NEW.

THE metaphysics of pure experience, which, as Professor James expresses it, is "in the atmosphere," is regarded by its exponents as in effect a new philosophy, and results of far-reaching importance are predicted for it. Its pragmatic method and its humanistic point of view are considered as likely to work a fundamental change in our notions concerning reality. In this spirit writes Schiller when he says, "The pragmatic method in philosophy bids fair to be as serviceable as the Darwinian in biology." It is held that pragmatism has reconstructed the meaning of old terms and given them an entirely different content. It promises to reinterpret the world, not in worn-out logical formulæ and musty epistemological concepts, but by categories cast in the moulds of fresh realism and filled with vital experience. On the other hand the critics of pragmatism are accused of using world-old arguments, familiar to Zeno. They are advocates of "temple-like" systems of thought; they deal in verbal subtleties and transcendental hypotheses beyond all possibility of experimental verification or even of imagination.

There is truth in these assertions as to the novelty of the pragmatic principle, and the antiquity of the arguments brought against it, but it is only a half truth. That the pragmatic method is something entirely, or even largely, new I cannot fully convince myself. There is much that is fresh and vigorous about humanism,—the

very fact that James and Dewey are among its most zealous advocates would assure this to be the case. These writers and their followers have made many neglected facts vital, have opened up forgotten vistas of truth and emphasized discarded realities; but for all this pragmatism has in it not a little that recalls the *πάντα ῥεῖ* of Hera-kleitus and the *homo mensura* of Protagoras. It is not to be wondered at, then, that these ancient doctrines find responses that date in part from the centuries when philosophic thought first formulated itself into clear expression on Hellenic soil; and we need not be surprised if we again witness a conflict similar to that which idealism once waged against sophism (and here I use the word in no objectionable sense, but in its original philosophical significance); that later realism fought with nominalism; and which in modern times absolutism has carried on with empiricism. It would seem as if we were once more to attempt to decide whether human experience is self-containing and self-satisfying; or whether we are not called upon to push beyond all experience, actual and possible, to those transcendent ideals of thought and action that Kant placed at the end of his philosophy.

Under such circumstances it should be of advantage to indicate the points of similarity between humanism and similar philosophical tendencies in the history of thought, and to make a note of the replies that from time to time have been made to the contention that phenomenal reality is "the be-all and the end-all" of existence. Hence it may be of service to gather these thoughts now so much in the air, in order that their trend may be more definitely discovered and their ultimate meaning outlined.

But right here the pragmatist will doubtless object that such a procedure is an attempt to categorize and make static something that can be comprehended only by experiencing it as a living, budding, growing system of real-

ity; but I can reply only by saying that to think means to do this very thing—that it is impossible to catch experience “on the fly,” that it must be made to an extent wooden and dead in order to be comprehended. Description, however real and exact, must always remain description, and to comprehend in any more than from a hand to mouth fashion we must go beyond description; we must bring in (sad as the necessity may be) our logical formulæ and metaphysical categories; we must “prepare” our realities if we wish to cross-section them for examination, we must stain them with the foreign matter of thought if we are to trace their windings and crossings. I know this is not pragmatic, except in so far as it is necessary, or at least useful, and then it should receive the full pragmatic sanction.

Let us then examine more closely what pragmatism means. Its opponents accuse it of subjectivism and pluralism (which the pragmatist denies with greater or less vigor) and its adherents admit its phenomenalism and make much of its utilitarianism. Its empirical and utilitarian aspects are considered to be positive merits, which the absolutists have failed to recognize as such, because of the perversity and hardness of their intellects and because of their own “comparatively slack hold on the realities of the situation.” But surely subjectivism, pluralism, phenomenalism and utilitarianism are by no means new doctrines, and for these aspects of pragmatism nothing particularly novel should be claimed. The points of view which these doctrines set forth to-day are in essence the same as they have been in the past, while the objections to them present a not fundamentally different attitude of mind in the present time than in past centuries. This the further discussion will attempt to amplify.

First, however, we must consider briefly the justice of the assertion that pragmatism is subjective and plural-

istic. The pragmatist categorically denies that he is a solipsist. Indeed James asserts that the doctrine has a more vital relation with realism than with the subjective scepticism of the English empiricists. Those who bring the accusation make much of the criterion of satisfaction employed by the pragmatist as a test of truth. Satisfaction, it is urged, is an individual matter. Royce, for example, maintains that for pragmatism truth means nothing more than that which just now meets my individual needs. To this the reply is made that the satisfaction which a situation calls forth attaches itself to something clearly objective. The individual consciousness is regarded as an element in the situation which continually develops. Professor Moore writes: "If we remember . . . that this sense of freedom and harmony* to which we last appealed is not any bare, detached, unmediated fragment of feeling that we may happen to find, but is the issue of a process of purposing and thinking, including experimentation and verification based on results of previous thoughts and actions, involving as many individual minds and as much of the material world as you will . . . the last suspicion of subjectivism disappears."

James also writes in a similar vein; "Humanism says that satisfactoriness is what distinguishes the true from the false . . . But nothing is more obvious than the fact that both the object and the past experience of the object may be the very things about it that most seem satisfactory and that most incite us to believe in them."

These two statements, as well as others of a similar nature, must be interpreted as meaning that a situation is not true because it is satisfactory, but merely that the truth gives satisfaction. Truth is ultimately conditioned by that which transcends the immediate experience and leads up to it. It is much as if we should say that it is

*i. e., satisfaction.

the high barometer which distinguishes pleasant from unpleasant weather, meaning by it only of course that the barometer is merely the indication of atmospheric states and in no sense a condition of them. In exactly the same way satisfaction on the whole accompanies those situations which we call true, but it does not make the truth, it merely registers the fact that certain relations and conditions beyond the satisfaction are in existence.

If then this is all the pragmatist intends by his statement he cannot mean in any final sense that the true *is* the satisfactory, but only that "which gives the maximal combinations of satisfaction." Truth and satisfaction are not the same. Satisfaction is the result of truth, the badge by which it is distinguished.

If this is all the doctrine means, I can hardly understand how any one, absolutist or empiricist, can dispute it. But in this particular pragmatism, then, it is no new discovery, or any departure from the generally accepted attitude of looking at reality. There is indeed nothing about which to dispute. No one but the most confirmed pessimist would for a moment maintain that on the whole and in the long run the false and the satisfactory coincide. I am inclined to think, however, there is in the mind of the pragmatist the feeling that in some way satisfaction is the body and essence of truth, just as according to the James-Lange theory a feeling of bodily change is the essence of emotion. If this latter interpretation is put on the assertion that truth is satisfaction then the charge of subjectivism and solipsism is difficult to disprove. Each and every state of intellectual satisfaction must then point to the truth, but this can hardly be accepted as a correct interpretation of the facts. Indeed it often seems as if the more dogmatic and ignorant the individual really is, by just so much his satisfaction in his assertions is intensified. There are less thought-crises and disturbances in the mind of such a

person than in that of the earnest searcher after truth. Who can say when measured from the standpoint of real satisfaction that the psychic calm of the unreflecting dogmatist is not on the whole greater than that of the critical investigator, and if greater then to that extent possessing more of truth?

If such a conception of truth be held to we are brought face to face with the revival of the contention of the Sophists as to the epistemological equality between desirability and intellectual reality, and we can not free such a conception from the charge of solipsism. But whether we take this narrower or the more liberal interpretation of the pragmatic statement that truth is satisfaction, we are confronted with no new doctrine.

In regard to the assertion that experience, which is the final reality for the humanist, is individual and hence subjective, the pragmatist asserts that experience as such (pure experience) is neither subject nor object, but rather the reality from which both develop. To James pure experience is "the instant field of the present," a simple *that* undifferentiated into thing and thought. It is naive immediacy retrospectively separated into two parts. In one center it plays the part of a knower, while in another it plays the part of the thing known. In one instance it figures as a thought, in another as a thing. It is the stuff from which everything is composed. Yet pure experience is not actually experienced as far as we know it as normal individuals. "Pure experience is the name which I give," says James, "to the original flux of life before reflexion has categorized it. Only new-born babes and persons in semi-coma from sleep, drugs, illness or blows can have an experience pure in the literal sense of a *that* which is not yet a definite *what*." Again, "Pure experience is but another form for feeling or sensation." Thus experience is made objective by being reduced to

mere sensation—sensation in general which belongs to no one in particular. Experience in this sense “may be taken as a point in which several experiences join. Thus several minds may know the same object.”

It is a question whether objectivity can be secured in this way; indeed according to one notion sensation and feeling are the most subjective of all mental elements, and a philosophy which makes them the ultimate reality is in danger of ending, as did that of Locke and Hume, in complete subjectivism. It is only by the most radical reconstruction of terms that such a doctrine can be made to serve its purpose of getting beyond the individual experience. The reconstruction as it stands would seem to hold something as follows: Sensation is a general term for an experience in general, and experience of nothing in particular and by no one in particular. From this experience which leans upon nothing, which sustains itself in the infinite void, is developed a consciousness that knows, and a world that is known. It itself is not consciousness, for consciousness is a function born of experience and conditioned by it. We have then an exact reversal of the ordinary way of thinking, which holds that experience demands as its condition a subject which experiences, a consciousness which conditions such experience. It is hard for those who have been inoculated with the Cartesian fiction(?) of the *res cogitans* to think in such terms as these. The words are understood, but the meaning will not readily be grasped—indeed we have no images by which to construe such a doctrine; it is as much beyond our experience as is the absolute of the most perverse and hide-bound idealist. It would be better to avoid the use of such terms as experience, feeling and sensation in setting forth this doctrine if it is to be comprehended. A better term for it would be the Kantian *x*. As such there

could be no objection to it, as expressing a mystery beyond comprehension.

I do not believe, however, that the pragmatist easily thinks in such terms. It is more probable that feeling and sensation mean for him what they mean for others, namely something quite individual and particular; and that experience for him means not experience in general but experience in particular, *my experience*; and truth based on such grounds is again open to the suspicion of subjectivism. On the whole it seems by no means certain that the pragmatist has escaped the charge of subjectivism, as he himself would have us believe.

We can more briefly discuss the alleged pluralism of the pragmatist's doctrine. The conception of pure experience as set forth by Professor James may claim from one point of view the merit of being monistic, since the pure experience is the stuff of all our derived and secondary realities. It is the finality itself—the brooding unity from which emerges the self and the world. Yet, on the other hand, Professor James explicitly asserts that “all experience is a process” and that “no point of view can ever be the last one. Every one is insufficient and off its balance.” Further, “there is vastly more discontinuity in the sum total of experience than we commonly suppose” and our experiences, taken all together, are “a quasi-chaos.” Whatever may be the monistic assumptions contained in the conception of a mere experience as such from which experience as we know it develops, it is certain that the experience in which the law of pragmatism holds good must be according to these above statements no more single or abiding than the universe of Herakleitus, nor more lastingly true than the world of Protagoras. Every-day experience is pluralistic. This is entirely in accord with the views of Professor James in his conceptions of the varieties of experience.

But a word need be said in regard to the empiricism of the doctrine of pragmatism. It is epitomized in the following statement of James, "Everything real must be experienced; and everything experienced must be real."

Utilitarianism is perhaps the most striking feature of the doctrine. It is everywhere affirmed. But only a few quotations are necessary here. Dr. Irving King declares that thinking has no other purpose than to solve the crises that arise within experience. "Science," says Schiller, "subordinates itself to the needs and ends of life, whether we regard its origin—practical necessity, or its criterion—practical utility." "The concrete truth *for us* will always be that way of thinking in which our various experiences most profitably combine" (James). Pragmatism is in complete sympathy with the scientific point of view, which holds according to James "that scientific theories are not copies of eternal truths, but are a conceptional short hand, true so far as they are useful, but no farther."

In pragmatism, then, we are confronted with a doctrine which in its statement at least seems open to the charge of subjectivism and pluralism; which clearly announces empiricism and utilitarianism, and which in these particulars far from being new is but a restatement—more careful and complete—of points of view centuries old. So far it is, in part at least, a revival of the anthropological categories of the Sophists; a restatement of the doctrine of Protagoras, who treated the problem of knowledge psycho-genetically, and as such it will be opposed to-day as it was opposed in antiquity. Schiller is certainly right in his opinion that "for a long time to come we must expect still to see the great principle of Protagoras maligned and perverted by those congenitally unfitted to appreciate it."

One of these congenital defectives of antiquity was Plato who felt that truth must be more than a merely

human affair, and who with one sweep of poetic imagination invented a world of pure ideas, changeless and abiding, and added thereunto the notion that all phenomenal realities were mere copies of these transcendent beings. Here we have absolutism and the "copy-theory" with a vengeance. Knowledge is the cognition of the eternal and necessary; experience is, indeed, a hindrance to such cognition. Thus did Plato attempt to escape from the dizzy whirl of "the instant field of the present." His was the first reply of the absolutists to the pragmatist, forceful but dogmatic.

It remained for a more systematic thinker, who had sympathy for both empiricism and absolutism, to set forth a more consistent theory of truth and reality. Aristotle was well fitted for his tasks. He was a scientist, who was also a philosopher. He recognized the value of empirical reality, but he clearly saw its hopeless limitations. In this great thinker we find the rare combination of the naturalist and the metaphysician. For him life was empirical and manifold and practical, but it was more; he saw the reality of the *νοσηκτι θπά's*, but he understood the necessity of *θεωρία* that attains to those highest truths that presuppose all knowledge. With wonderful clearness he recognized the value of empiricism and transcendentalism. He saw the worth of those practical activities that were to be measured by results, but he had too rich an experience to ignore the fact that in appearance we constantly strive after a universal element. So while not turning his back on experience, he asserted that the soul must possess a faculty of immediate knowledge, the postulates of all thinking. Real knowledge is gained through experience, but passes beyond the phenomenal world. In brief, Aristotle felt the force of the pragmatic fact that knowledge develops in experience, that as far as we know truth it is in evolution; but he also recognized the necessity

which thought imposed of thinking the relative in absolute terms—and then, impelled by the demands of thought to satisfy itself, he posited such an absolute, whose existence thus became as certain as that of thought itself, since to unthink it was, if consistency were prized, to end all thought.

Aristotle's logic was a central point in the thinking of the early Middle Ages, and hence arose the dispute concerning the meaning of logical relations and the conflict over universals. The nominalists of those days find their counterpart in the scientific pragmatists of to-day, who consider the categories of science to be valid only in so far as they serve as convenient means of manipulating the material with which they deal, but who hold the ultimate reality of these categories as a matter of entire indifference. The realists on the other hand are closely allied to the absolutists of the present generation, who are unwilling to admit that truth is merely truth in evolution, but who assert the ultimate and transcendent value of those conceptions which are designated as true. It was an adherent of realism, Anselm of Canterbury, who formulated the much abused and sadly misunderstood Ontological Argument to combat the nominalism of his opponents. We find this argument outlined in the *Proslogium*, and in brief it consists in the statement that the thought of God as the most perfect being involves the existence of God. The paraphrase of this argument by Guanilo, and later by Kant, made it appear ridiculous, but the real meaning of the truth here expressed was suspected neither by his mediæval nor his modern critic. The significance of the argument lies in the fact (clear to Aristotle) that the human mind must think something ultimate (we may call the ultimate God or what you will), and having thought the ultimate it must further affirm the existence of such an ultimate. There are only two paths open to the seeker after

reality. The reality is either mere subjectivity of sophism, or it is something that transcends subjectivity (not only my consciousness, but the consciousness of all finite individuals); further if we once allow ourselves to transcend this psychic immanence, we are forced to go on to that which is without limit or condition, to the highest species that embraces all below it (stated in logical terms), or to the ultimate cause lying behind all conditioning and temporal causes, to the metaphysical reality as distinguished from the mere occasional realities of the phenomenal world (stated in ontological terms). When all has been said and done the realist and the absolutist assert in opposition to the nominalist and empiricist that *something exists somewhere and somehow*. This is the one vital point of the entire problem, as vital to-day as when the question was formulated in Boethius's translation of Porphyry's Introduction. It is no new point of view, then, that pragmatism is upholding in this respect, but one which the human mind has found interesting and necessary since the classic period of Greek philosophy.

The metaphysics of pure experience is clearly affirmed in modern times by the great English empiricist Hume. All comes from sensation, and in the last analysis all ends with sensation, since no reality can be posited beyond, neither a material world nor a thinking substance. This radical empiricism contents itself with a purely positivistic point of view and is entirely in harmony with the pragmatism of to-day. Indeed the modern doctrine is a thoroughly legitimate development of the Humian standpoint, and completely in accord with a science of mind which finds states of consciousness all that psychology needs to do its work with.

Kant attempted to answer the subjectivism and empiricism of Hume. The result may be considered largely a failure as far the Critique of Pure Theoretical Reason

is concerned. Here we can know only phenomena. In his ethical treatises, however, Kant succeeds in transcending the individual and relative point of view and in getting beyond the world of change. Here he seems to assert the reality of those final ideals which remain mere ideals in his theoretical philosophy. They are demanded by faith and for faith are real. The same argument, however, holds good (though Kant did not apply it) in the theoretical sphere. Phenomena as such yield no satisfaction to thought, which demands the unconditioned, and hence must assert the unconditioned as a matter of intellectual faith, thus attaining a knowledge that is adequate to the Ideas of Reason.

This step the later German philosophy took in the idealistic optimism of Hegel and his predecessors. Thought overcomes all contradictions and imperfections and attains to the absolute which it demands from its own necessity.

Neo-Hegelianism states with wonderful clearness the fundamental motive of this conception, centuries old, in the proof of Professor Royce for the existence of God. It runs as follows:

"Reality as opposed to illusion, means simply an actual or possible content of experience, not in so far as this experience is supposed to be transient and fleeting, but in so far as it is conceived to be something inclusive and organized, the fulfillment of a system of ideas." But since we have no such experience as an actual fact in finite existence, we must argue to an Absolute Experience, to God. In other words, the fragmentary reality which human experience knows is unsatisfactory; but thought can not rest here. Since there is no perfect fulfillment of the ideal in the finite, there must be an infinite to realize such a fulfillment. Here we find again in a modern and much improved form, but still in essence the same as of old, the Ontological Argument of Anselm.

This, then, is the final point to which our discussion leads. Can we rest content in the "instant field of the present," or must we push out to the beyond? The pragmatist does not deny that such a transcendence must in part take place, but he would limit its scope to human experience. Once admit the principle of objective reference, however, and there is no stopping place. From the pure experience of the moment we push on to an experience complex with relations that yield no ultimate satisfaction to our thought. The phenomenal world of radical empiricism cannot fulfil our ideals and we are forced through sheer necessity (the same necessity which actuated Plato and Aristotle and Anselm and Kant and Hegel) to posit a world of eternal abiding reality beyond all hope of growth or shadow of change. We strive after the universal element in appearance. The "thought-crises" constantly arise and are never satisfied within individual experience. In contradistinction to this mode of thinking, pragmatism offers only a partial adjustment, "a relation of less fixed parts of experience to other relatively more fixed parts, and not a relation of experience to anything beyond it" (James). Such a point of view then must always remain unsatisfactory to that type of mind that holds up to itself the ideal of completeness; and there is no type of mind that does not, explicitly or implicitly, openly or covertly, possess to some degree such an ideal. This lack of the recognition of such a necessity is the one great defect of the pragmatic doctrine. On the other hand it expresses a great truth (one too often ignored by absolutism) that the detailed working out of our thoughts is in a field of practical, immanent reality in which all that is actual is either directly experienced or capable of statement in images derived from experience. Truth is not a copy of an external reality, but the expression of harmonies between elements of actual experience. So far

the doctrine has great practical value. Such a truth, however, is transient and is not the ideal truth that our thinking demands. We can never, it is true, in human experience arrive at any other truth; hence the pragmatist asserts that this other truth, since it cannot be brought into relation with our lives, makes no difference and its existence or non-existence is a matter of no concern. That which, however, does make a difference is the attitude which we have toward the reality of such a transcendent truth. If we deny it, then we must admit that one truth is as good as another, since all are relative and transient, and no point of view, even if tested by ages of human thinking, can be nearer any abiding standard than another. In the infinity of possible experience any actual experience or set of experiences is infinitesimal. Indeed such a relative standard is condemned by the pragmatic criterion of satisfactoriness as impossible. *We must think the absolute, therefore the absolute exists.* And finally we have at the conclusion of our discussion this anomaly.

The pragmatist, if he is consistent, is obliged to posit for intellectual satisfaction an absolute, while on the other hand the absolutist, in asserting the reality of the transcendent, has no other warrant than that of the pragmatist, its practical necessity for thought.

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SOME NOTES ON THE IDEOGRAMS OF THE CHINESE AND THE CENTRAL AMER- ICAN CALENDARS.

ALEXANDER von Humboldt long since observed that:

“In Mexico from the seventh century until our era the days have been called ‘tiger,’ ‘dog,’ ‘monkey,’ ‘hare,’ or ‘rabbit,’ as throughout eastern Asia the years bear the same names among the Tibetans, the Tatar-Manchus, the Mongols, the Kalmüks, the Chinese, the Japanese, and among the nations of Tonkin and Cochinchina.”

The learned scientist contrasted the day-names of the Mexican system with the year-nomenclature of the Asiatic races: sinologists have since demonstrated that the symbols now employed in China to designate the years were originally proper to the days alone, and that their use in connection with the “cycle of years” dates only from the first century of our era.

The invention of the system of time-measurement, current at the present day in China, Japan, Korea, Siam, Tibet, and the neighboring countries, is ascribed by Chinese tradition to Huâng-tí,* B. C. 2636, though, according to Dr. Chalmers, the first known occurrence of the cyclical name of a day in Chinese literature is found in the *Shū Ching*—the “classic of history”—under the first year of

* In transcribing Chinese sounds, the modern pronunciation of Peking is followed throughout these notes. Chinese characters inclosed in [] are antique forms.

the emperor T'ai-chia, B. C. 1752. "This is the only instance of the use of the cycle which occurs before 1121 B. C.," after which date it begins to be referred to by Chinese writers as a thing well established and known to all men.

These Chinese time-symbols, twenty-two in number, consist in two series of very ancient ideographic characters, obscure in origin and significance: one set of ten, known as "the celestial stems," and one of twelve, "the terrestrial branches." The commentary on the classical work called the "Record of Rites"—*Li Chi*—states that:

"Tá-não [a minister of the fabulous Huâng-tí mentioned above], having traced out the relations of the five elements and ascertained by divination the laws regulating the movements of the constellation of the Great Bear, invented the symbols *chià*, *yí*, etc., to name the days, calling this series 'stems'; and for naming the moons used the signs *tzù*, *ch'òu*, etc., which he styled 'branches.' By the combination of these 'branches' and 'stems' he completed the six decades of days."

Each of the twelve branches is under the tutelage of a particular animal, and the ten stems are assigned to various manifestations of the five elements—water, fire, wood, metal, and earth,—recognized by Chinese philosophy.

In ancient Mexico, a series of twenty symbols served to designate the days, and though, so far as we are aware, no division analogous to that of the Chinese stems and branches was made, we yet find that one-half of these Mexican characters bear the names of animals, and the remaining half the names of certain objects and influences in nature.

The following tables exhibit the arrangement of the two series of characters, Asiatic and American:

I. THE CHINESE SERIES.

A. The Ten Stems.

NUMBER.	SYMBOLS		NAME.	ASSIGNMENT.	ELEMENTAL INFLUENCE
	ANCIENT.	MODERN.			
1.	甲	甲	chià	fir tree	wood
2.	乙	乙	yi	bamboo	wood
3.	丙	丙	píng	torch flame	fire
4.	丁	丁	ting	lamp flame	fire
5.	戊	戊	móu	hill	earth
6.	己	己	chì	plain	earth
7.	庚	庚	k'eng	weapon	metal
8.	辛	辛	hsin	cauldron	metal
9.	壬	壬	jên	wave	water
10.	癸	癸	kuèi	stream	water

B. The Twelve Branches.

NUMBER.	SYMBOLS		NAME.	ASSIGNMENT.
	ANCIENT.	MODERN.		
1.	子	子	tzù	rat
2.	丑	丑	ch'òu	ox
3.	寅	寅	yín	tiger
4.	卯	卯	mào	hare
5.	辰	辰	ch'én	dragon
6.	巳	巳	ssú	serpent
7.	午	午	wù	horse
8.	未	未	wéi	goat
9.	申	申	shen	monkey
10.	酉	酉	yù	cock
11.	戌	戌	hsū	dog
12.	亥	亥	hái	boar.

No. 10 is also written *yu*.¹ Several other forms of No 12 are found.

¹ 酉

II. THE MEXICAN SERIES.

NUMBER.	SYMBOL.	NAME	MEANING OF NAME.
1.		cipactli	dragon
2.		ehecatl	wind
3.		calli	house
4.		cuetzpalin	lizard
5.		coatl	serpent
6.		miquiztli	death
7.		mazatl	deer
8.		tochtli	rabbit
9.		atl	water
10.		itzquintli	dog
11.		ozomatli	monkey
12.		malinalli	grass
13.		acatl	cane
14.		ocelotl	tiger
15.		quauhtli	eagle
16.		cozcaquauhtli	vulture
17.		ollin	movement
18.		tecpatl	flint

19.		quiahuatl	rain
20.		xochitl	flower.

Von Humboldt considered the similarities between the two series so remarkable as to declare that:

"The six signs of the Tatarian zodiac (i. e. dragon, serpent, dog, hare, monkey, tiger) which are also found in the Mexican calendar, are sufficient to make it extremely probable that the nations of the two continents have drawn their astronomical ideas from a common source, and it is worthy of notice that the points of resemblance on which we insist are not derived from rude pictures or allegories susceptible of being interpreted in accordance with any hypothesis that it is desired to sustain."

The eminent Americanist, the late Dr. D. G. Brinton, takes issue with this pronouncement and finds cause to remark:

"Years ago, Alex. von Humboldt assigned it (the Central American calendar system) the first rank among the proofs that they (the American nations) had reached a certain degree of true civilization, indeed, so deeply did its intricacies impress him that he could not believe that it was wholly developed by tribes so uncultured in some other respects, and sought for its chief principles of origin among the civilizations of Asia. . . . A profounder study of the subject, rendered possible by more abundant documents, especially of a linguistic character, has shown that the hypothesis of the great naturalist is unnecessary, and indeed contrary to the evidence. The peculiarities which marked this calendar belong to itself alone, and differ completely from those on which the time-counts and astronomical measurements of the ancient nations of the Old World were based. It is strangely and absolutely independent in its origin and development."

So far Dr. Brinton.

Some of the peculiarities that marked the American system were: the beginning of the year at the winter solstice; the reckoning of time by a lunar as well as by a solar year, and in addition the employment of a ritual year of

260 days, or 20 periods of 13 days each; the division of the year into 72 periods of 5 days each, or 4 seasons of 18 weeks; the addition of intercalary days at the end of the year, by which the length of the solar year was fixed approximately at 365 days; the arrangement of the years in cycles by indictions, each year of the cycle bearing a compound designation, one element of which is the name of an animal.

In view of the fact that every one of these "peculiarities" exists also in the Asiatic calendar system, Dr. Brinton's assertion that the characteristics of the American calendar "belong to itself alone, and differ completely from those on which the time-counts and astronomical measurements of the ancient nations of the Old World were based," is susceptible of at least some degree of modification.

As a result of his "profounder study of the subject, rendered possible by more abundant documents, especially of a linguistic character," Dr. Brinton in his *Native Calendar System of Central America and Mexico*, undertook an exhaustive etymological analysis of the calendar names in the different central American languages, in the endeavor "to reach the symbolical significance of the calendar as a mythical record and method of divination." He designedly avoids any analysis of the written characters, believing that the aid thence to be derived is fallacious, and arrives at the conclusion that:

"Whatever other uses of an astronomical and time measuring character the calendar had, the best known and most general service which it rendered was for divining purposes. . . . The basic theory of the art of divination according to the calendar is nowhere stated. I propose to form a suggestion as to what this was, as appears to be indicated by the calendar itself, and to be supported by a number of collateral facts mentioned by early authors."

Dr. Brinton's suggestion is, that the 20 American calendar names constituted an esoteric résumé of the course

of human life and its vicissitudes. His linguistic analyses reveal that:

"Restoring the figurative terms to their literal meaning, we may conclude that the general and original symbolism of the day-names in all the tongues in which we have them, were as follows:

NUMBER.	SYMBOL.	HIERATIC SIGNIFICATION
1.	sword fish	birth, the beginning.
2.	wind	breath, life, the soul.
3.	darkness, the house	sleep, rest, repose.
4.	iguana	food, nourishment.
5.	snake	sexual life, reproduction.
6.	death	child-bearing, children.
7.	deer	hunting.
8.	rabbit, seed	agriculture.
9.	water, rain	illness or productiveness.
10.	dog	hardship and suffering, and success through them.
11.	monkey	difficulties surmounted.
12.	broom, teeth	loss, evanescence.
13.	reed	cold, drought, advancing years.
14.	tiger	learning, wisdom.
15.	eagle, bird	knowledge, skill.
16.	vulture, owl	old age, misfortunes.
17.	motion	debility, failing powers.
18.	flint knife	war, death.
19.	lightning	sickness, destruction.
20.	sun	the house of the soul."

Dr. Brinton continues:

"The examination of this sequence reveals that it was intended to cover the career of human life from the time of birth until death at an old age. The individual emerges from the womb of his mother and the parturient waters, as did the earth from the primeval ocean. He receives breath and with it life, which is supported by repose and food. The man reproduces his kind; the woman, at the risk of her life, brings the child into the world. The chase and tilling the ground are the leading occupations of peace; and he who holds firm through illness, suffering, and hardships, will gain the prizes of life. Having reached the acme of his career, a decline commences, losses

multiply, years increase, and though knowledge and wisdom are augmented, old age comes on apace, with failing powers, with vanquished struggles, with sickness and death; until at last, its course run, its task complete, the soul quits the worn-out body and soars to its natural haven and home, the abode of the sun. Such, it seems to me, without any straining, is the philosophical conception of life which was intended to be conveyed by the symbols of this strange old calendar. They may not have originated contemporaneously with it, certainly not if it was primarily deduced from astronomical observations, but quite probably if, instead of this, it was built on terrestrial relations and mythical concepts."

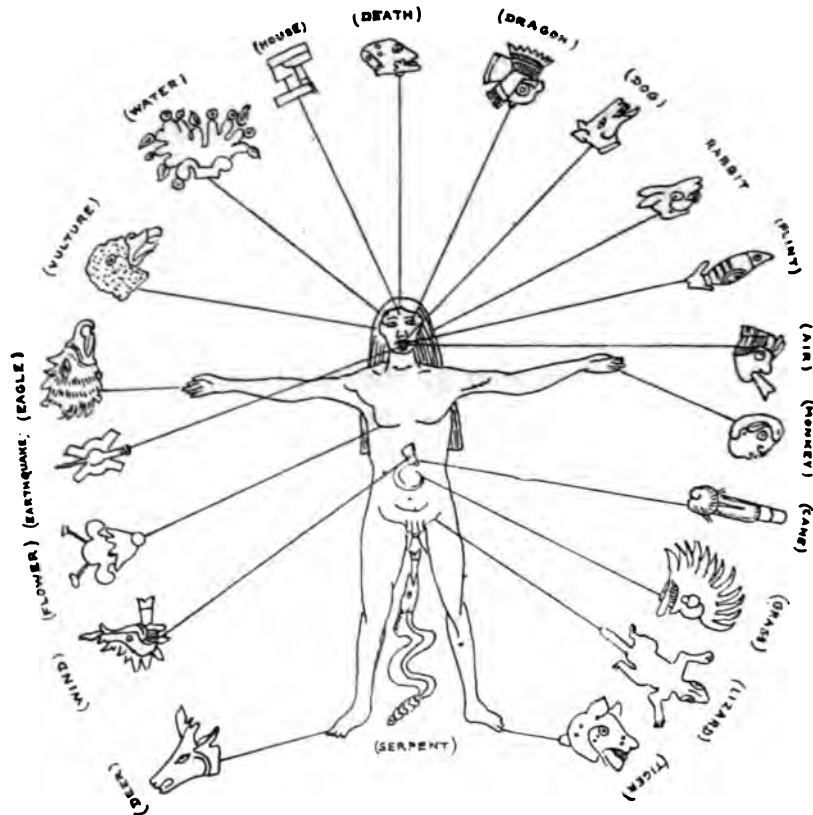
The question naturally presents itself: What can a similar analysis of the Asiatic day-names, based on "more abundant documents, especially of a linguistic character" than were available in Von Humboldt's time, reveal?

According to Dr. Brinton, the best known and most general service rendered by the American calendar was for divining purposes. It is unnecessary to advert to the connection between the cyclical ideograms and the art of divination in Asia. Every student of Chinese is familiar with the rôle played by the Ten Stems and the Twelve Branches in the astrologer's gramarye, and their never-ending reference to the points of the compass, the elements, the horary periods of the day, the various animals, the members of the body, and a thousand and one other alleged relations to the constituent parts of existence; and how upon their procession and interaction, in one order or another, are founded all the predictions of the diviner in regard to the secrets of nature and of being.

As a single instance. A figure in the Mexican manuscript catalogued as "Codex Vaticanus" exhibits the ascription of the day-emblems to the various parts of the human body. In Chinese almanacs of the present day may frequently be seen the pictures of the gods of the four seasons, their forms besprinkled with disks bearing the symbols of the Twelve Terrestrial Branches.

Dr. Carus very appositely suggests that similar presentments are common in mediæval European works on astrology and may be met with, not infrequently, in almanacs even of our own times.

Is it not curious to remark that in both these figures—



ASSIGNMENT OF DAY EMBLEMS TO THE PARTS OF THE HUMAN BODY.
From Mexican Codex in Vatican Library.

American and Asiatic—the sign of the “tiger” is at the left foot; that the “hare” and the “cock” on the shoulders of the Chinese deity are paralleled by the “rabbit” and the “vulture” on the sides of the Mexican; and that the “lizard” in one and the “rat” in the other,—creatures which several

circumstances tend to equate in cyclical nomenclature,—preside over the belly?

But to return. Are there any grounds for a belief that the Asiatic ideograms were intended "to cover the career of human life from the time of birth until death at an old age?" If this is so, the fact helps to strengthen very materially the evidence in favor of the derivation of the two calendars from a common source. The question is best answered by the characters themselves.



ZODIAC EMBLEMS ASSIGNED TO THE
PARTS OF THE HUMAN BODY.

From a contemporary Western almanac.



CHINESE SUMMER GOD.

From modern Chinese Almanac, substituting translations for the native characters of the twelve 'branches.'

In the Chinese field, we can not follow Dr. Brinton in ignoring the assistance to be derived from the written characters, for Chinese etymology is based not on phonetics but on a comparison and analysis of the oldest forms of the ideographic symbols.

Roughly speaking, each Chinese character is composed of two parts: one called a "radical" or "classifier," which is a conventional representation of the class of objects to which the character relates; and another, technically

known as the "phonetic complement," being a picture of some common object, usually totally unconnected in meaning, but the name of which has the same sound, with that of the object or idea denoted by the whole composite character. Consequently, from the very nature of Chinese writing, to quote Dr. Edkins,

"The sound of the 'phonetic' part of a character is an index to the sound of the words when the characters were first made.... Anciently, words like in their 'phonetic' symbols were like in sound. This is at once recognized by every one in simple cases.... We may proceed further than this, and say that when difficulties occur in discovering similarity in sound, it is in every case due to changes effected by time in the sounds of the words."

The modern Chinese sounds, in their myriad dialectic variations, can not afford a trustworthy basis for etymological deduction; the old phonetic symbols must be relied on for help in that direction.

ANALYSIS OF THE CHINESE IDEOGRAMS.

1. *The First Stem, Chia.*²

Dr. Wells Williams, in his *Syllabic Dictionary of the Chinese Language*, defines this character as: "the plumule or scaly covering of a growing seed just bursting; cover of a sprout; a bud;" and says "the original character is described as composed of *mu*,³ "wood," with a cap over it, representing the first movements of the sprout in spring." Dr. Chalmers prefers to regard *chia* as an original ideogram, and makes no analysis of its component parts. His definition is: "a protecting cover; helmet." It may be remarked, *en passant*, that the Chinese, Aztec, and Maya day-symbols correspond in so far at least that they are all non-composite, or what sinologists would term "primitive" characters. The Imperial K'ang-hsi Lexicon tells us that "grass and trees beginning to grow" are called

² 甲

³ 木

by this name *chia*, and among ancient forms of the character listed by that authority occurs one,⁴ in which *jen*,⁵ the ideogram for "man," is placed on top of the sign *chia*⁶ referring directly, as it would seem, to the opening period of human life. Surmounted by *jih*,⁷ "the sun," similarly the character *tsao*,⁸ has the meaning "early." Surrounded by *men*,⁹ "the two leaves of a folding door," its significance is the same,—“the door just open to admit the rays of the rising sun.”¹⁰ There is also a close resemblance between the old form of this stem *chia*¹¹ and that of *ch'üan*,¹² "a fountain," "a spring." The upper part of both characters is like *mi*¹³ (old sound *mik*), "a protecting cover," which enters frequently into the composition of Chinese symbols (Cf. the Maya *mac*¹⁴ of supposedly similar name). Etymologically connected may be: *chia*,¹⁵ "to hide away," "put in the bosom," "cherish"; *chia*,¹⁶ "a metal undershirt." The general idea conveyed by this first stem and its derivatives is something hidden awakening into life,—the commencement of plant life in particular.

2. The Second Stem, *Yi*.¹⁷

This is defined as "a curling sprout or bud just coming out of the darkness and seclusion of winter." Chalmers says "the bursting of vegetation...this (ideogram) denotes effort in *ch'ien*,¹⁸ 'dry,' 'strong,' 'advancing'; *luan*,¹⁹ 'to unravel,' 'confusion,' and *yu*,²⁰ 'excess.' " In the K'ang-hsi Lexicon occur two very similar characters, now obsolete, *ya*,²¹ defined as *nan ch'u chih mao*, "the appearance of difficulty in coming forth," and *yin*,²² described as an old form of *yin*,²³ "to conceal." These and the stem symbol depict very plainly: (i) the motionless plant hidden in the

4 命 5 人 6 甲 7 日 8 早[早] 9 門 10 開開
11 [中] 12 泉[泉] 13 一[一] 14 一[一] 15 挾 16 輪 17 乙[乙]
18 乾 19 亂 20 尤 21 乙 22 乙 23 隱

ground,²⁴ and the different forms it takes when sprouting under (ii) favorable²⁵ and (iii) unfavorable²⁶ circumstances. The stem name is etymologically connected with *yi*,²⁷ "one," "the first." The K'ang-hsi lists an old form of *jih*, "the sun," which consists in a circle enclosing this second stem,²⁸ i. e., the one circle, the great disk. Other connections, real or imaginary, are: "to let loose"²⁹; "to overflow";³⁰ "to rush on," as to battle;³¹ "to unfold," "to fly"³²; "standing ready"³³; "coming suddenly"³⁴; "full"³⁵; "exuberant"³⁶; "to increase"³⁷; "to pour out"³⁸; "to be ready to overflow"³⁹;—all now pronounced *yi*. The ideas conveyed by the second stem, then, are (i) the uncurling of a sprout and coming out from darkness, and (ii) oneness, unity, the consciousness of the ego.

3. The Third Stem, Ping.⁴⁰

One authority says: "Composed of *yi*,⁴¹ 'one,' *ju*,⁴² 'to enter,' and *chiung*,⁴³ 'a receptacle or door'; *yi*⁴¹ representing the *yang*⁴⁴ principle." In other words, this is the sun entering the door, the dawn of reason in the individual. *Yi*, "one," is here used as the equivalent of the old sun symbol alluded to under the last stem. In modern Chinese and Japanese, the sun is styled *t'ai yang*,⁴⁵ *taiyo*, "the great positive principle." The dictionary *Shuo-wen T'ung-hsün Ting-sheng* arrives at the same conclusion by slightly different analysis. This character, it says, is the original of *ping*,⁴⁶ "fiery," "bright," "conflagration," and *tsai*,⁴⁷ "fires under a cover," is an old form of the same. The top line is the same as *shang*,⁴⁸ "to ascend," and the rest is "fire under a roof" contracted. The concept of "brightness" and "flame" runs through the cognate characters.

24 乚	25 乙	26 乚	27 一	28 囧	29 逵	30 洑
31 𡗗	32 𡗗	33 𡗗	34 𡗗	35 𡗗	36 𡗗	37 𡗗
38 𡗗	39 𡗗	40 丙	41 一	42 𡗗	43 𡗗	44 𡗗
	45 太陽	46 炳	47 𡗗	48 上		

and the stem symbol itself is used in Canton to write the local word *ping*, "to burn." Surmounted by the "sun" ideogram, the stem means "bright and glorious like the sun," and has the same name, *ping*.⁴⁹ Infancy is now past and the child is advancing into the brightness of youth,—such seems to be the meaning conveyed by the symbol. Possible connections are: *ping*,⁵⁰ "bright," "luminous"; *ping*,⁵¹ "to have power"; *ping*,⁵² "power"; *ping*,⁵³ "to confide in"; *p'ing*,⁵⁴ "undisturbed."

4. The Fourth Stem, *Ting*.⁵⁵

This is the figure of a nail or peg, anything firmly fixed or settled. Dr. Williams says it denotes "that things are perfected...robust and full grown person...to sustain, to bear." Another old form of the character is composed of *jen*,⁵⁶ "man," over *chüeh*,⁵⁷ "hook," the latter said to stand here for *hsin*,⁵⁸ "the heart;" the man's heart is established, full of determination and courage. With the addition of the sign for "weapon," indicating martial prowess, the character *ch'eng*⁵⁹ has the meaning "complete," "perfected." A character⁶⁰ occurring on a bell of the Shang dynasty, cited by Edkins, and identified with this *ting* stem, bears some resemblance to the *ch'eng* symbol. On a tripod of Fu-ting is found a quite dissimilar form,⁶¹ which may represent the head of a nail; a third old form,⁶² is a very fair picture of the nail in full. This last ideogram is identified by some with *liang*,⁶³ "honest," "upright." In Peking, a young man, sixteen to eighteen years of age, is styled *ting-nien*,⁶⁴ "arrived at manhood," and this is exactly the idea appropriate to the position occupied by the *ting* stem in the sequence. Related words are numerous: *ting*,⁶⁵ "a nail," "a spike"; *ting*,⁶⁶ "firmly set-

49 昌 50 炳 51 秉 52 柄 53 凭 54 平 55 丁[个]
56 人[刀] 57 丁[匕] 58 心[匕] 59 成[咸] 60 [𠂔] 61 [𠂔] 62 [𠂔]
63 良 64 丁年 65 釘 66 鼎

tled"; *ting*,⁶⁷ "peak," "summit"; *ting*,⁶⁸ "secure," "fixed," "steady"; *ting*,⁶⁹ "ballast"; *ting*,⁷⁰ "honest," "trusty"; *t'ing*,⁷¹ "decided," "resolute"; *t'ing*,⁷² "baton of authority"; *t'ing*,⁷³ "good," "complete," "full," "whatever is the purpose of life."

5. The Fifth Stem, *Wu* or *Mou*.⁷⁴

Supposed to be a form of *mou*,⁷⁵ "an ax or halberd," but probably used phonetically for *mou*,⁷⁶ "luxuriant," "ripe grain," "when all things are flourishing," with which both Edkins and Williams connect it. The characters *ch'eng*,⁷⁷ and *hsien*,⁷⁸ written with the same phonetic element, mean "complete," "perfect," "all." Connections with *mou*,⁷⁹ "luxuriant"; *mou*,⁸⁰ "force of purpose," "to exert one's mind"; *mou*,⁸¹ "male," "virility"; *mou*,⁸² "to deliberate," "to ponder"; *wu*,⁸³ "to bend the mind to a subject"; *wu*,⁸⁴ "to gallop furiously"; *mou*,⁸⁵ "to do business," "carry on commerce";—are more or less probable. The leading idea is activity, the business of life.

6. The Sixth Stem, *Chi*.⁸⁶

The native lexicologers do not explain the form of this symbol, but all are agreed as to its signification: "one's self." It resembles ideograms employed to depict "breath" and "air." Williams says: "This character is connected with the center of a thing, as it is considered to be altered from *chung*,⁸⁷ "the middle," and because it is the sixth of the ten stems." Of similar meaning are *chi*,⁸⁸ "to exhaust a subject"; *chi*,⁸⁹ "to stand up." The man is now "himself," has come to his own, having accomplished the purpose of life, and the gradual descent to the grave begins.

67 頂	68 定	69 訂	70 停	71 挺	72 踴	73 壬
74 戊戌	75 際	76 際	77 際	78 際	79 際	80 際
81 杜	82 謀	83 務	84 薦	85 贊	86 己己	87 中中
		88 紀	89 起			

7. *The Seventh Stem, Keng.*⁹⁰

"The original form represents the hands receiving a thing, as at autumn when all things are full...to change, to alter, age; to bestow reward." In Chalmers' opinion it is composed of *kung*,⁹¹ "to lift up the hands together," and *kan*,⁹² "to violate"; the latter element being phonetic. *Kan* itself is composed of *ju*,⁹³ "to enter," inverted, and *yi*,⁹⁴ "one." His definition is: "joining on to, as the border or foot of a garment." The main idea seems to be either (i) change, alteration; or (ii) rewards of labor; *cozca-quauhltli* and *ollin* are the American analogs. Connected may be: *keng*,⁹⁵ "to change"; *keng*,⁹⁶ "a limit," "an extreme point"; *keng*,⁹⁷ "a path leading to a sepulchre"; *keng*,⁹⁸ "to thrum the threads of a lute rapidly, so as to endanger breaking them."

8. *The Eighth Stem, Hsin.*⁹⁹

From *yi*,¹⁰⁰ "one," and *ch'ien*,¹⁰¹ "error," explained as depicting "the arms of a man holding up a thing, referring to the sorrow one feels at winter coming." *Ch'ien* is from *kan*,¹⁰² "to violate," under an old form of *shang*,¹⁰³ "superiors." The ordinary meaning of *hsin* is "a bitter, sharp, pungent taste"; whence, by metonymy, because the peppery taste makes the tears flow, "toilsome," "suffering," "grievous," "sad," "the melancholy feeling in autumn when vegetation turns sere." The Shuo-wen says it is composed of *ch'ien*,¹⁰⁴ "to offend superiors," plus an extra stroke,¹⁰⁵ showing the enormity of the crime. The meaning of sadness and failing powers is appropriate to the position occupied by the character in the stem series.

90 庚[庚]	91 [戌]	92 干[干]	93 入[入]	94 一	95 更	
96 瓦	97 埴	98 埴	99 辛[辛]	100 一	101 [辛]	102 [干]
		103 [二]	104 [辛]	105 [一]		

9. *The Ninth Stem, Jen.*¹⁰⁶

According to Dr. Williams, "defined as a man standing on the earth, the earth denoting the business of life." Others say it represents the embryo in the womb. It resembles *t'ing*¹⁰⁷ in form, and as a phonetic element is often interchanged with *jen*,¹⁰⁸ "sincere." Other meanings are: "running water," "great," "full," "to flatter." Edkins' account is: "Plants growing out of the ground, with the sense *t'ing*, 'grow upward.' This stem is very similar in form to *t'ing* and indeed seems to be confounded with that symbol by some of the authorities." Chalmers' definition of the *jen* stem is "to sustain, to bear . . . probably a derivative of *kung*,¹⁰⁹ "work," like *chü*,¹¹⁰ *wu*,¹¹¹ *ch'en*,¹¹² and *ya*,¹¹³ and the middle line denotes the person doing the work intended." The character, as now written, consists in the sign for "scholar" with an additional stroke on top. Concerning the *t'ing* ideogram, Chalmers says that the old form¹¹⁴ shows a man standing on the soil, meaning "to stand up," "go." It is probable that the *jen* sign is used phonetically for a character, now read *jen*,¹¹⁵ meaning "sincere," "sure," "trusty," "rely upon," "a trust," "an office," "to undertake," "be responsible for," "the incumbent," "acting official." Other words with the sound *jen* have significations suitable to the position of this emblem among the stems; e. g., *jen*,¹¹⁶ "to dwell on with satisfaction," as a well-spent life, we may opine; *jen*,¹¹⁷ "fortitude," "endurance"; *jen*,¹¹⁸ "grain which is fully ripe"; *jen*,¹¹⁹ "the yellowish color of an old sword." The significance of this symbol lies in its reference to the completion of the affairs of life and to pleasurable retrospection.

	106 壬[王]	107 壬	108 仕	109 工	
110 巨	111 巫	112 臣	113 亞	114 [王]	115 任
	116 恁	117 忍	118 稔	119 初	

10. *The Tenth Stem, Kuei.*¹²⁰

The old form in the shape of a cross is, according to the native etymologists, the same as the modern *kuei*,¹²¹ "arms," "tridents," "arrows," etc. The modern form,¹²² from the Li¹²³ writing, is also old, and is said to be a combination of *po*,¹²⁴ "to stop," "to hinder," (from *chih*, "to step," in two positions), with *shih*,¹²⁵ "an arrow," i. e., to send home an arrow. The dictionary Shuo-wen, commenting on the old "cross" form, points out that it represents "water flowing from the four quarters and entering the ground." Williams states that "the original form is like two sticks laid across to represent water flowing into the ground in all directions." Edkins, following the Liu-shu Cheng-wei, thinks that the two pieces of wood placed crosswise "formed no other than an ancient implement used in leveling." This was called *kuei*,¹²⁶ and used by builders in reducing land to a level. In the variety written with the arrow sign, Edkins detects *pei*,¹²⁷ "north," and *shih*,¹²⁸ "arrow." The north belongs to winter, and *kuei* is applied to both. "Both earth and water," on the authority of the Shuo-wen, "then become smooth and flat and can be easily measured." Streams flowing together are now *kuei*,¹²⁹—a similar sound but differently ideographed. A place where four roads meet is also *kuei*.¹³⁰ All the authorities identify the lower part of the *kuei* stem with the "arrow" sign, but the forms of the two are not quite the same. (See Wu-yin Chih-yün and Chih-yün in K'ang-hsi, s. v. *kuei*.¹³¹) The etymological connections are very interesting and suggestive. That which most naturally presents itself is,—as suggested by the Cheng-yün,—"to return," *kuei*,¹³² "to go to," "to send back," "to revert to the original place,"

120 癸	121 戔	122 癸	123 隸	124 𠂔
125 𠂔	126 規	127 北	128 矢	129 溜
		131 晷	132 歸	130 達

used in the phrase *kuei wu*,¹³³ "to revert to nothingness," "to die." Other relations are: *kuei*,¹³⁴ "strength all gone out"; *kuei*,¹³⁵ "water all dried up," as in a fountain or well; *kuei*,¹³⁶ "to change," "to alter"; *kuei*,¹³⁷ "the day, but especially the shadow," as in *fei kuei*,¹³⁸ "time flies." The tortoise, *kuei*,¹³⁹ emblem of longevity, and the juniper tree *kuei*,¹⁴⁰ whose durable wood is prized for making coffins, as also *kuei*,¹⁴¹ "the spirit of a dead man," are all called by this same name *kuei*; and it is curious to note that the "disk of the sun" *kuei*,¹⁴² and the "sunflower" *kuei*,¹⁴³ are similarly designated, in connection with the fact that the last day-name in the American calendars is "sun," the home of the soul, otherwise styled *xochitl*, i. e., "flower."

Summarizing the results attained by these analyses of the "Ten Stems," we obtain a sequence somewhat as follows:

1. *Chià*; the sprout is still hidden in the ground, but begins to feel the impulse of life and shoots upward;
2. *Yi*; it has reached the surface and uncurls;
3. *Ping*; the sun reaches it; and beneath his influence
4. *Ting*; it stands upright; and gaining vigor,
5. *Móu*; spreads forth luxuriantly; until, as a tree,
6. *Chì*; it has reached its full growth; and
7. *Kēng*; its fruit is gathered;
8. *Hsin*; decay sets in; the leaves fall;
9. *Jên*; the seed is again hidden in the ground; and
10. *Kuèi*; at the close of the year, there is a return to the original darkness, and the processes of nature enter on a new cycle of life.

As the "ten stems" have reference to the operations of nature in the procession of the seasons, so it can be shown that the "twelve branches" relate to man's affairs in particular.

	133 歸無	134 効	135 屬	136 梔	
137 墨	138 飛墨	139 龜	140 檟	141 鬼	
	142 規	143 葵			

*A. The First Branch, Tzu.*¹⁴⁴

This is explained as the "figure of a baby strapped on its mother's back. The legs are swathed together in their wrappings, hence represented by a single stroke. An old form¹⁴⁵ is recorded, where the three vertical lines on top show the hair. The character presents no difficulty; it is in everyday use, with the meaning "child," "son."

*B. The Second Branch, Ch'ou.*¹⁴⁶

The original form resembles a hand holding things. Others say: "it is like *shih*,¹⁴⁷ 'ten,' inside of *erh*,¹⁴⁸ 'two,' because the twelfth month is called *ch'ou yüeh*."¹⁴⁹ Further old forms are *ch'ou*¹⁵⁰ and *ch'ou*.¹⁵¹ The latter may be compared with the Maya sign,¹⁵² supposed by some to be a "hand." The radical idea is holding, grasping, guiding; referring perhaps to the care of the parents for their offspring. Compare the ideograms of "grasping a son"¹⁵³ and "grasping a daughter,"¹⁵⁴ both synonymous with *hao*,¹⁵⁵ "to love." Of like sound and meaning with the branch character are *ch'ou*,¹⁵⁶ all expressive of "to hold"; *chou*,¹⁵⁷ "to environ," "to provide for"; *chou*,¹⁵⁸ "to shade," "to conceal"; *ch'ou*,¹⁵⁹ "to hold, as the earth does"; *ch'ou*,¹⁶⁰ "to conceal by holding in the elbow"; *ch'ou*,¹⁶¹ "to take out with the end," "to lift"; *ch'ou*,¹⁶² "to arrange details."

*C. The Third Branch, Yin.*¹⁶³

Williams, citing some metaphysical abstractions of the Shuo-wen, says: "From *mien*,¹⁶⁴ 'a covering,' which is likened to the kneepan that prevents the humors from ascending the body. These humors are depicted by *chiu*,¹⁶⁵

144 子[子]	145 [子]	146 丑[丑]	147 十	148 二	149 丑月	
150 [子]	151 [子]	152 [子]	153 𠂔	154 𠂔	155 𠂔	156 紐紐
157 周	158 俯	159 由	160 肘	161 袖	162 袖	
163 寅[寅]	164 一[一]	165 巳				

'a mortar,' as coming out of the ground, and including the stimulus of nature in spring which the frost hinders . . . 'to reverence,' 'to respect,' 'respectful,' 'a fellow officer,' 'a colleague,' 'vigorous,' 'strong.' This is not over-intelligible to the Occidental mind. In the oldest forms, the character is composed of a central part, said to be a modification of *jen*,¹⁶⁶ the "man" sign; *chü*,¹⁶⁷ "the hands brought together," "to clasp the hands"; and *mien*,¹⁶⁸ "a house," "a covering." With this compare the character *hsüo*,¹⁶⁹ "to educate," where may be seen the "child," *tsu*,¹⁷⁰ under a "shelter," *mien*;¹⁷¹ above, the signs of "imitation," *hsiao*,¹⁷² and of "guiding hands," *chü*;¹⁷³ intimating that, in the process of education, the protected child is guided and taught to imitate. Suggested connections: *yin*,¹⁷⁴ "to take an interest in"; *yin*,¹⁷⁵ "to shelter"; *yin*,¹⁷⁶ "to regulate," "to sustain"; *yin*,¹⁷⁷ "to lead on," "to point out," "bring forward"; *yin*,¹⁷⁸ "careful," "anxious"; *yin*,¹⁷⁹ "to move forward," "to journey"; *yin*,¹⁸⁰ "to nourish"; *yin*,¹⁸¹ "covered," "in private life," "not in office." To this branch may be allotted the meaning of early studies, the child being instructed in the respect due to its parents. With this *ch'ou* symbol compare *fu*,¹⁸² "father," where a hand grasping the rod of authority is pictured.

D. The Fourth Branch, Mao.¹⁸³

The old form is like an open door, or rather the two leaves of a double door, "analogous to the springing up of vegetation in March." It is defined by *mao*,¹⁸⁴ "a cover," as the earth is then covered. This last symbol, *mao*, "a cover," has, among other meanings, that of "rushing heedlessly," "venturing," "going forward," and the branch-sign itself is used in divers binomial expressions with a

166	天	167	目	168	門	169	學	170	引	171	門		
172	天	173	目	174	震	175	陰	176	殷	177	引	178	震
179	天	180	飲	181	隨	182	父	183	叩	184	冒		

like signification, as "calling the roll," *tien mao*,¹⁸⁵ "answering a summons," *chou mao*.¹⁸⁶ The symbolism may be the venturesomeness of youth or the responding to the roll-call of duty when the period of instruction, typified by the preceding branch, is over.

*E. The Fifth Branch, Ch'en.*¹⁸⁷

The ancient form is supposed to depict "sprouting plants transformed by heaven... 'to excite,' 'to occasion,' 'to move,' 'to influence.'" Such is Dr. Williams' definition. The native lexicon *Shuo-wen T'ung-hsün* Ting-sheng says that the old form is composed of the sign for a human being, and another, meaning something concealed, the whole having the meaning "pregnant."

*F. The Sixth Branch, Ssu.*¹⁸⁸

This is the picture of a serpent, the animal emblematic of the sixth branch. It refers to the fourth moon, says one authority, when all nature is in vigor. The ideas conveyed by this symbol and that of the last branch correspond with those associated in Mexico with the skull and serpent, *miquiztli* and *coatl*, motherhood and fatherhood.

*G. The Seventh Branch, Wu.*¹⁸⁹

The figure of a pestle, defined as expressing "the resistance which the earthy vapors of the fifth moon, hence called *wu yüeh*,¹⁹⁰ oppose to the skyey influences, thus covering the earth with fog." This sign is used with *wu*,¹⁹¹ "to oppose," "to stand up," "to resist," "cross," "transverse." Chalmers points out that the seventh branch has the sense of crossing. It denotes the sun at noon, and hence the meridian of life. Its form is very similar to that

¹⁸⁵ 點卯

¹⁸⁶ 畫卯

¹⁸⁷ 辰圖

¹⁸⁸ 巳圖

¹⁸⁹ 午[午]

¹⁹⁰ 午月

¹⁹¹ 迂

of the "stem" called *ting*,¹⁹² and both may possibly have been symbols of reproduction.

*H. The Eighth Branch, Wei.*¹⁹³

This is *mu*,¹⁹⁴ the "tree" symbol, with an extra line at the top, showing the abundance of foliage and the tree's full vigor in the sixth month. So say the lexicologists. The character is a common adverb of negation and doubt, "not yet." Although the midday has passed, the set time has not yet expired, *meh ssu meh le li*, as the Shanghai vernacular has it. This is the counterpart of *mou*¹⁹⁵ among the "stems."

*I. The Ninth Branch, Shen.*¹⁹⁶

"Formed," says Willims, "of *chiu*,¹⁹⁷ 'a mortar,' and *kun*,¹⁹⁸ 'to join.' Others say the character is intended to represent the backbone... 'to extend,' 'to stretch,' 'reiterate,' 'prolong,' 'increase.' " The Shuo-wen says that the element which Williams makes out as *chiu*,¹⁹⁷ "a mortar," is *chü*,¹⁹⁹ "the two hands holding or grasping" (found in the third branch *yin*²⁰⁰), and that the stroke *kun*¹⁹⁸ pictures the body; the whole representing a man placing his hands to his sides and stretching himself. The character is emblematic of weariness and declining years, as in the eighth stem.

*J. The Tenth Branch, Yu.*²⁰¹

One old form is a figure of a vessel used for distilling, "referring to the closing up of nature in the eighth moon, when crops are ripe... 'ripe,' 'finished,' 'mature,' 'as ripe millet fit for making spirits,' 'the ripeness of crops.' " This branch is assigned to the west, and bears a great likeness to some old forms of the symbol *hsi*,²⁰² "west," employed

192 丁[𠂔] 193 未[𠂔] 194 木[𣎵] 195 戊 196 申[申] 197 白
198 丨 199 𠂔 200 寅 201 酉[酉] 202 西

in writing the name of that cardinal point. *Hsi*, however, is said to picture "a bird sitting on its nest at sunset." Another old form²⁰³ of this branch shows "a door barred," the antonym of the fourth branch,²⁰⁴ which is "an open door." This typifies the closing, as the other does the opening, of life. Some connected words: *yu*,²⁰⁵ "an old building whose timbers are decayed;" *yu*,²⁰⁶ "dark," "obscure," "hidden from view," "shades or spirits who are in obscure places"; *yu*,²⁰⁷ "grieved," "mournful"; *yu*,²⁰⁸ "to float," "to travel to," "go away."

K. The Eleventh Branch, *Hsü*.²⁰⁹

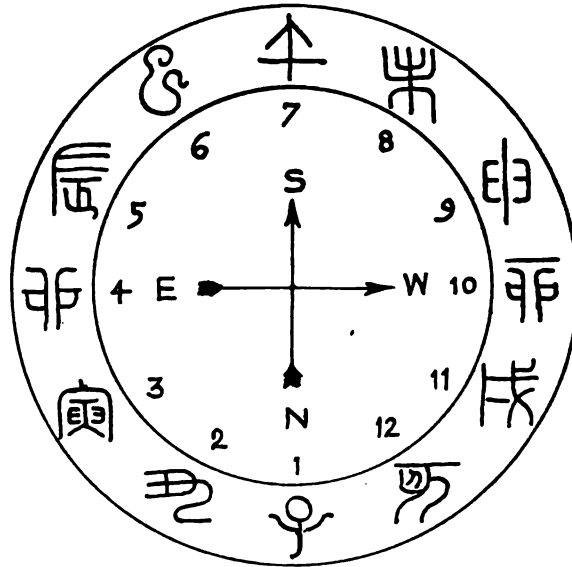
This is *wu*, the fifth stem, with the addition of a short horizontal line, perhaps denoting the wound made by the weapon, or the movement in throwing the spear. Compare other symbols of motion, such as *mou*,²¹⁰ "the long-handled ax attached to a chariot," where the dictionary makers tell us that the waved line is indicative of the revolutions of the instrument; also *ch'ou*,²¹¹ "to plow," showing the furrows and the "boustrophedon" movement; also *sheng*,²¹² "to ascend," where the three short lines are said to show the steps of the sun on his upward path. The meaning of this branch is "hurt," "pitiable," correlative with the *hsin* stem, and referring to nature fading in the ninth moon and the closing of human life. Others say it is symbolical of "fullness, for things start in *wu* (the fifth branch) and get ripe in *hsü* (this eleventh branch) when the sun's heat declines."

L. The Twelfth Branch, *Hai*.²¹³

The Shuo-wen says this is just another form of *shih*,²¹⁴ "a pig." Williams thinks it is made of *jen*,²¹⁵ "man" above,

203 𠩺	204 𠩻	205 𠩼	206 𠩽	207 𠩾	208 𠩿
209 戌	210 亥	211 子	212 丑	213 寅	214 卯
		215 人			

and *nü*,²¹⁶ "woman" below. None of the authorities gives any satisfactory explanation of the character, and its old forms are quite numerous and dissimilar. The sound *chu*²¹⁷ means "to drive out," and *sui*²¹⁸ means "to scatter"; both of these are written by the "pig" symbol, so that it is probable, or, on Edkins' theory of the phonetic complements, almost certain that the old sound of these words was *shih*, or whatever the old-time name of the hog may have been. It is not improbable then, that this *hai* branch



may have had the meaning "drive away," "scatter," although, etymologically, it seems rather to be connected with words meaning "young child." (Cf. also *chu*,²¹⁹ *chu*.²²⁰) One old form²²¹ contains, apparently, the elements *jen*,²²² "man," and *yin*,²²³ "to conceal," which might lead to the supposition that the character has reference to the tomb. This explanation is offered with hesitation, as it rests on no native authority.

²¹⁶ 女[𡚦]

²¹⁷ 逐

²¹⁸ 遂

²¹⁹ 豕

²²⁰ 猪

²²¹ 𡚦

²²² [人]

²²³ [冂]

The Twelve Branches are assigned to the cardinal points, beginning at the north, the region of winter and darkness; passing around through the east (spring), the south (summer), to the west (autumn), and thus back to the north again, as shown in the foregoing diagram.

In this arrangement the symbol of the opening door in the east and that of the closing door in the west are immediately noticed. The position of the two characters *yin*²²⁴ and *shen*,²²⁵ each containing the "hand" sign, also arrests the attention. This placement of contrasting emblems was evidently premeditated and offers a clew to the interpretation to be given to some of the ideograms whose significance is more or less obscure.

The child, *tsu*,²²⁶ in the north, is set opposite the man in the prime of life, *wu*,²²⁷ in the south. (Cf. the form and meaning of the stem *ting*²²⁸). The restraining hand, *ch'ou*,²²⁹ stands over against the tree in its unrestricted exuberance of foliage, *wei*.²³⁰ *Yin*,²³¹ where may be seen the child, *jen*,²³³ emerging from the home, *mien*,²³⁴ as yet sustained by the parental hands, *chü*,²³⁵ and exulting in his new-found strength, is opposed to *shen*,²³⁶ the man stretching himself in world-weary languor. Then come the opening and the closing doors; and next *ch'en*,²³⁷ a symbol of the beginning of life, in opposition to *hsü*,²³⁸ indicative of approaching dissolution. While to complete the series there is the antonymy of *ssu*,²³⁹ "the serpent," a genetic sign, as against *hai*,²⁴⁰ "the man concealed," alluding, as may be supposed, to the last home and resting-place of the soul.

Several circumstances tend to show that the eleventh and twelfth branches originally occupied a different place in the series, and that the sequence began with what is now

224 寅[寅]	225 申[申]	226 [巳]	227 [午]	228 [未]	229 [申]
230 [酉]	231 [戌]	233 [亥]	234 [子]	235 [丑]	236 [寅]
	238 [卯]	239 [辰]	240 [巳]		

the third symbol; but this fact does not materially alter the significance of the series, since it is to be regarded as continuous and never-ending, a delineation of the ceaseless interaction of the positive and negative principles in the great scheme of being.

RECAPITULATION.

Having thus predicated a community of intention on the part of the framers of these cycle-names in regard to the lesson to be conveyed by the sequence of symbols, the attempt may perhaps be made to compare the individual characters of the two continents yet more closely.

The first stem, *chia*, represents the seed beginning to sprout under the influence of the sun's rays in spring. One of the derivations proposed for the Maya, Tzental, and Quiché-Cakchiquel name of the first day, *imix*, *imox*, connects it with *mex* or *mix*, "the beard," and metaphorically "the sun's rays."

The second stem, *yi*, shows a young plant coming out from darkness into the air and light of day, and this ideogram also conveys the idea of individuality, self-consciousness, the dawn of reason. In the Zapotec calendar the second day was *ni*, "to grow," "increase," "gain life," or *laa*, "warmth," "heat," "reason," "intelligence." In the Maya, Tzental, Nahuatl, Quiché-Cakchiquel, (and also sometimes in the Zapotec), the second day is *ik*, *igh*, *ik*, *gui*, *ehcatl*, all meaning "air," "life," "soul."

The third stem *ping* pictures the sun entering a house or covering. The third Mexican day is *calli*, "house."

The fourth stem, *ting*, is an emblem of virility and reproduction. *Cuetzpálin*, the lizard, is the fourth Mexican day, and this creature was the ruler of the womb and loins. In Tzental the fourth day was *ghanan*, a name referring to the god of plants and abundance.

Chi, the sixth stem, is, as has been seen, considered by

some Chinese authorities as a variant of *chung*, "the middle," "the center." The Zapotec *lana*, meaning "separate," "apart," "the middle," and the Tzental *tox*, "what is separated," are applied to the sixth day in the American series.

The seventh stem, *keng*, contains a "hand" sign, as does also the symbol for *manik*, the seventh Maya day.

Jen, the ninth stem, is referred to the pregnant womb and is assigned to the element water. In Maya and Tzental, *muluc*, *molo*, names of the ninth day, mean "to pile up," "to heap up," while the Zapotec term *niza* and the Nahuatl *atl* both mean "water," and are employed as names of the ninth day in those calendars.

It was seen above that the interpretation ordinarily given to the seventh branch of the Chinese series was "pestle." In the Meztitlan dialect of the Nahuatl, the sixteenth day was known as *temetlatl*, which also signifies "pestle."

It will be noticed that the Ten Stems of the Chinese series are distributed by pairs among the five elements, the first member of each group being allied to the *yang*,²⁴¹ or active principle of the dual philosophy, and the second to the *yin*,²⁴² or passive principle. For instance, under the element "metal," the stem "weapon"—the "metal" of the warrior—is assigned to the aggressive *yang*, and the stem "cauldron"—the "metal" of the home—to the unassuming *yin*. A similar antonymy prevails among the other stems. The raging "wave" is opposed to the tranquil "stream"; the sturdy "fir" to the slender "bamboo"; the fierce flame of the "torch" to the feeble glimmer of the primitive "lamp"; the rugged "mountain" crag to the orderly cultivated "plain."

There is no particular evidence of a similar division of the American sequence, though it is apparent at a glance

that here are two terms assignable to the aqueous element "water" (*atl*) and "rain" (*quiahuitl*); three vegetable products, "flower" (*xochitl*), "grass" (*malinalli*), and "cane" (*acatl*.) The "flint" (*tecpatl*) may be considered as a representative of "fire," and the "earthquake" (*ollin*) as a manifestation of earthy influence. *Calli*, "the house," as of mineral origin, may perchance form a second in the "earth" group. There remain "wind" (*ehecatl*) and "death" (*miquiztli*); no great stretch of imagination is required to pair the gentle zephyr and the noxious spirit-breath of death in a group ruled by the element "air,"—recognized in Mexican though ignored in Chinese science and if fancy may be accorded yet further license, and the "cane"—either from its use in blowing fires or as employed in the frictional production of that element—be transferred to the "fire" group, an American series of "elementally assigned" stems is built up, arranged in groups of two and exhibiting antonymies roughly corresponding with and perhaps not more fantastic than those of the Asiatic scheme. "Water," represented by the active "rain," as against the passive "water" in the bowl (cf. the ideogram *atl*). "Wood," the gorgeous "flower" of the cactus offsetting the lowly, every-day "grass." "Earth," in its active manifestation as the all-destroying "earthquake"; passive and immovable, on the other hand, as molded into the vast pile of the *teocalli*, the "house" of the gods. "Air," the fierce all-conquering breath of "death" and the cool refreshing "breeze" of spring. "Fire," the *yang* manifestation produced on the instant from the "flinty rock," and the *yin* avatar of the lordly element brought about by the action of the "cane" spindle of the fire-mill.

Turning now to the animal names, composing the other half of the series, one encounters the "dragon," the "snake," the "rabbit," the "dog," the "monkey," and the "tiger" on both shores of the Pacific. In other words, on

is confronted, as remarked by Gustav Schlegel, by the truly remarkable fact that, of the ten zoological terms of the Mexican cyclical nomenclature, no less than six are absolutely identical with those dedicated to a like purpose in far-away Asia; and since the "eagle" or "vulture" may be accepted without demur as the counterpart of the "cock," the assertion can be made that all but three of the Mexican names find their representatives in the Chinese list. As against the "lizard," "deer," "eagle," and "vulture" of America, there remain the Asiatic "rat," "ox," "horse," "goat" and "pig." The lizard and the deer, creatures very familiar to the Mexicans, may be taken as the analogues of the rat and the ox, (Schlegel equates the lizard with the dragon); the horse and the pig, as animals not indigenous, may reasonably be supposed to have been dropped from the list by those who adapted the series to American use; while the goat, also not a native of Mexico, a rock animal, may have been replaced by the vulture, a bird of the crags.

Such an assignment of the American terms is, no doubt, far-fetched and fantastic,—it is intended as a mere suggestion,—but to those accustomed to follow the history of written characters, of words, of customs, in their migrations from land to land, from people to people, it will rather be matter for surprise that such striking coincidences between the two calendars should be visible on the surface to the casual observer at this day.

In the reassignment of the zoological terms just attempted, the Asiatic and American names were provisionally paired as follows:

(The numerals preceding the names indicate their order in the series.)

CHINESE.		MEXICAN.	
1	tzù rat	4	cuetzpalin lizard
2	ch'òu ox	7	mazatl deer

3	yîn	<i>tiger</i>	14	ocelotl	<i>tiger</i>
4	mào	<i>hare</i>	8	tochtli	<i>hare</i>
5	ch'ên	<i>dragon</i>	1	cipactli	<i>dragon</i>
6	ssú	<i>serpent</i>	5	coatl	<i>serpent</i>
7	wù	<i>horse</i>	—		
8	wéi	<i>goat</i>	15	quauhtli	<i>eagle</i>
9	shen	<i>monkey</i>	11	ozomatli	<i>monkey</i>
10	yù	<i>cock (bird)</i>	16	cozcaquauhtli	<i>vulture (bird)</i>
11	hsū	<i>dog</i>	10	itzquintli	<i>dog</i>
12	hái	<i>boar</i>	—		

Placing now the Maya day-glyphs (corresponding with these Mexican day-names) side by side with the Chinese symbols, thus:

1	tzù			4	kan
2	ch'òu			7	manik
3	yîn			14	ix
4	mào			8	lamat
5	ch'ên			1	imix
6	ssú			5	chicchan
7	wù		—	—	
8	wéi			15	men
9	shen			11	chuen
10	yù			16	cib
11	hsū			10	oc
12	hái		—	—	

it will be noticed that:

1. The Maya "grasping hand" sign, *manik*, the seventh American day, finds a place opposite the Chinese "grasping hand," *ch'ou*;

2. Corresponding with the Chinese "tiger" branch, *yîn*, comes the Maya *ix*, the fourth day, translated "sorcerer" by Dr. Brinton, a name connected with *balam*, "tiger," and metaphorically "wise man," since the Mayas supposed their sorcerers to possess the power of trans-

forming themselves into tigers. In this connection, the statement found in the Second Appendix to the Chinese Classic of Divination, *Yi-ching*, — that “the great man produces his changes as the tiger does when he changes his spots,” is worthy of notice. Dr. Seler thinks that the Maya glyph *ix* itself “shows the round hairy ear and spotted skin of the jaguar”;

3. The character *mao*, ascribed to the Chinese day of the “hare” is a picture of an “opening door,” typifying the Orient, sunrise, spring. The Maya *katun* corresponding with the Nahuatl day of the rabbit, *tochtli*, is *lamat*, concerning which Dr. Brinton says: “The figures (of *lamat*) bear a close resemblance to some sun signs... they seem to show the orb partly below a line, the horizon”;

4. The symbol appertaining to the Chinese “dragon” branch, *ch'en*, is defined by Dr. Wells Williams as “sprouting plants transformed by heaven.” Answering to the Nahuatl “dragon” day, *cipactli*, was the Maya *imix*, which Perez regards as a transposition of *ixim*, “maize.” Again *cipactli* is considered by some writers to denote the “sword-fish” or other marine monster, and Dr. Brinton notes that the head of a fish symbolized the fructifying and motherly waters. One of the Shuo-wen’s explanations of *ch'en*, is, as has been stated above, “pregnant”;

5. The glyph *chicchan*, the fifth day, identified by Seler as a serpent’s skin, corresponds exactly with the Nahuatl *coatli* and Chinese *ssu*, both pictures of snakes;

6. *Chuen*, the eleventh day, the equivalent of the Mexican *ozomatli*, is explained by Brasseur and Seler as “a monkey’s mouth”; it thus corresponds with the Chinese “monkey” branch, *shen*;

7. *Cib*, the symbol of the fourteenth day, is especially noteworthy. It is the correlate of the Nahuatl *cozca-quauhtli*, the “vulture,” and is paralleled by the Chinese day of the “cock,” whose ideogram is *yu*, “a jar of spiritu-

ous liquor," *ci*, "trickling down." The "pottery decoration" (the short parallel strokes several times repeated around the edge of the glyph) certainly indicates the jar or vase." The Tzental name, *chabin*, for this sixteenth day, has, as some of its meanings, "end," "funereal rites"; with which compare the second form (closing door) of the Chinese character, referred to the death of the day, the setting sun, the fall of the year. The fact that *chab* in the Quiché-Cakchiquel dialects means "arrow" might perhaps suggest a comparison of the Tzental *chabin* with the tenth Chinese stem *kuei*, said by some to depict an arrow come to rest, and referring, as does the Tzental word, to the closing scenes of the life-drama.

* * *

Among the Twelve Branches, the ideograms *mao* and *yu*, the opening and closing doors, spring and autumn, east and west, sunrise and sunset, are especially prominent. In the Maya series, three glyphs have been regarded by divers authorities as sun symbols:

Imix	
Lamat	
Akbal	

Imix is taken to represent the sun's rays, like the Egyptian hieroglyph *maau*²⁴³ and the Chinese *shih*.²⁴⁴ *Lamat* is said to picture the disk of the great luminary under some peculiar condition; Dr. Brinton sees in it "the orb partly below a line, the horizon," and from etymological analogies (*lambat*, i. e., "*hundirse in cosa blanda*") explains it as "the sunset." The Chinese pictogram *tan*,²⁴⁵ presenting the sun and a line, the horizon, has the reverse meaning, "sunrise," and so far as form is concerned may be compared with the Maya *akbal*, said to show the rays

243  244  245 

of the sun after sinking below the horizon, and connected with the word *akab*, "night."

Assuming for a moment that the identification of *lamat* as a solar emblem is correct; disposing the series in such a way that this glyph *lamat* comes opposite its Asiatic correlate *yu*, "the closing door"; and ranging the signs which precede and follow the *lamat* glyph in the Maya calendar in the *regular* sequence; thus:

CHINESE.			MAYA.		
1	tzù, child	子	—		
2	ch'òu, hand	手	—		
3	yîn, shelter	廄	☰	1	imix, food
4	mào, opening door	𠔁	☷	2	ik, wind
5	ch'ên, containing	𠔁	☷	3	akbal, evening
6	ssú, serpent	巳	☷	4	kan, iguana
7	wù, pestle	杵	☷	5	chicchan, serpent
8	wéi, foliage	𣎵	☷	6	cimi, death
9	shen, stretching	𢇛	☷	7	manik, hand
10	yù, closing door	西	☷	8	<i>lamat</i> , sunset
11	hsü, wounding	𠔁	☷	9	muluc, heap
12	hái, boar	豕	☷	10	oc, dog

We find here that the signs *ik*, *akbal*, *kan*, *chicchan*, *cimi*, *manik*, *lamat*,—"wind," "night sun," "iguana," "serpent," "death," "grasping hand," "sunset," form a series roughly corresponding with the Asiatic sequence of "sunrise," "dragon," "serpent," "pestle," "foliage," "pressing hands," "sunset." If we omit from the Chinese list the "horse" branch, *wu*, whose ideogram is the "pestle,"²⁴⁶ and which, as before noted, does not seem to have had analogs in the American series, we obtain the following category:

4	sunrise	☀	☀	3	sun symbol
5	dragon	龍	龍	4	iguana
6	serpent	蛇	蛇	5	serpent
7	—	—	—	—	—
8	foliage	葉	葉	6	death
9	hands	手	手	7	hand
10	sunset	夕	夕	8	sunset

Here the Maya sun symbols are parallel with the Chinese signs of similar import; the iguana and the serpent of the Maya pair off with the dragon and the serpent of the Chinese; and the "hands" of the *shen* branch correspond with the "hand" of the *manik* day. While the symbols of the two series do not form absolutely identical pairs, yet the *relative* positions of the signs in regard to the general series is the *same* in the Chinese list as it was in Mayapan.

RICHARD H. GEOGHEGAN.
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FAIRBANKS, ALASKA.

THE FRANKLIN SQUARES.

THE following letter with magic squares of 8×8 and 16×16 are copied from "Letters and papers on Philosophical subjects by Benjamin Franklin, LL. D., F.R.S.," a work which was printed in London, England, in 1769.

FROM BENJAMIN FRANKLIN ESQ. OF PHILADELPHIA,

TO PETER COLLINSON ESQ. AT LONDON.

DEAR SIR:

According to your request I now send you the arithmetical curiosity of which this is the history.

Being one day in the country at the house of our common friend, the late learned Mr. Logan, he showed me a folio French book filled with magic squares, wrote, if I forget not by one Mr. Frenicle, in which he said the author had discovered great ingenuity and dexterity in the management of numbers; and though several other foreigners had distinguished themselves in the same way, he did not recollect that any one Englishman had done anything of the kind remarkable.

I said it was perhaps a mark of the good sense of our mathematicians that they would not spend their time in things that were merely *difficiles nugæ*, incapable of any useful application. He answered that many of the arithmetical or mathematical questions publicly proposed in England were equally trifling and useless. Perhaps the considering and answering such questions, I replied, may not be altogether useless if it produces by practice an habitual readiness and exactness in mathematical disquisitions, which readiness may, on many occasions be of real use. In the same way says he, may the making of these squares be of use. I then confessed to him that in my younger days, having once some leisure

(which I still think I might have employed more usefully) I had amused myself in making these kind of magic squares, and, at length had acquired such a knack at it, that I could fill the cells of any magic square of reasonable size with a series of numbers as fast as I could write them, disposed in such a manner that the sums of every row, horizontal, perpendicular or diagonal, should be equal; but not being satisfied with these, which I looked on as common and easy things, I had imposed on myself more difficult tasks, and succeeded in making other magic squares with a variety of properties, and much more curious. He then showed me several in the same book of an uncommon and more curious kind; but as I thought none of them equal to some I remembered to have made, he desired me to let him see them; and accordingly the next time I visited him, I carried him a square of 8 which I found among my

52	61	4	13	20	29	36	45
14	3	62	51	46	35	30	19
53	60	5	12	21	28	37	44
11	6	50	54	43	38	27	22
55	58	7	10	23	26	39	42
9	8	57	30	41	40	25	24
50	63	2	15	18	31	34	47
16	1	64	49	48	33	32	17

Fig. 1.

old papers, and which I will now give you with an account of its properties (see Fig. 1). The properties are:

1. That every straight row (horizontal or vertical) of 8 numbers added together, makes 260, and half of each row, half of 260.
2. That the bent row of 8 numbers ascending and descending diagonally, viz., from 16 ascending to 10 and from 23 descending to 17 and every one of its parallel bent rows of 8 numbers make 260, etc., etc. And lastly the four corner numbers with the four middle numbers make 260. So this magical square seems perfect in its kind, but these are not all its properties, there are 5 other curious ones which at some time I will explain to you.

Mr. Logan then showed me an old arithmetical book in quarto,

wrote, I think by one Stifelius, which contained a square of 16 which he said he should imagine to be a work of great labour; but if I forget not, it had only the common properties of making the same sum, viz., 2056 in every row, horizontal, vertical and diagonal.

200	27	252	249	8	35	40	57	72	89	104	121	136	153	168	185
58	39	26	7	250	261	218	199	186	167	154	135	122	103	90	71
108	219	230	251	6	27	38	59	70	91	102	123	134	155	166	187
60	37	38	5	262	229	220	197	188	165	156	133	124	101	92	69
261	216	233	245	9	24	41	56	73	88	105	120	137	152	169	184
55	42	23	16	247	264	215	202	183	170	151	138	119	106	87	74
203	214	265	246	11	22	43	54	75	86	107	118	139	150	171	182
53	44	21	12	245	236	213	204	181	172	149	140	117	108	85	76
265	212	267	244	13	20	45	52	77	84	109	116	141	148	173	180
51	46	19	14	243	238	241	206	179	174	147	142	115	110	83	78
207	210	239	242	15	18	47	50	79	82	111	114	143	146	175	198
49	48	17	16	241	240	209	208	177	176	145	144	113	112	81	80
196	221	228	253	14	29	36	61	68	93	100	125	132	157	164	189
62	35	30	3	254	227	222	195	190	163	158	131	126	99	94	67
194	223	226	255	2	31	34	63	66	95	98	127	130	159	162	191
64	33	32	1	266	263	224	193	192	161	160	129	128	97	96	65

Fig. 2.

5	8	9	12
14	15	2	3
11	10	7	6
4	1	16	13

Fig. 3.

Not willing to be outdone by Mr. Stifelius, even in the size of my square, I went home, and made that evening the following magical square of 16 (see Fig. 2) which besides having all the properties of the foregoing square of 8, i. e., it would make 2056 in all the

same rows and diagonals, had this added, that a four-square hole being cut in a piece of paper of such a size as to take in and show through it just 16 of the little squares, when laid on the greater square, the sum of the 16 numbers so appearing through the hole, wherever it was placed on the greater square should likewise make 2056. This I sent to our friend the next morning, who after some days sent it back in a letter with these words:

"I return to thee thy astonishing

"or most stupendous piece

"of the magical square in which"....

—but the compliment is too extravagant and therefore, for his sake, as well as my own I ought not to repeat it. Nor is it necessary,

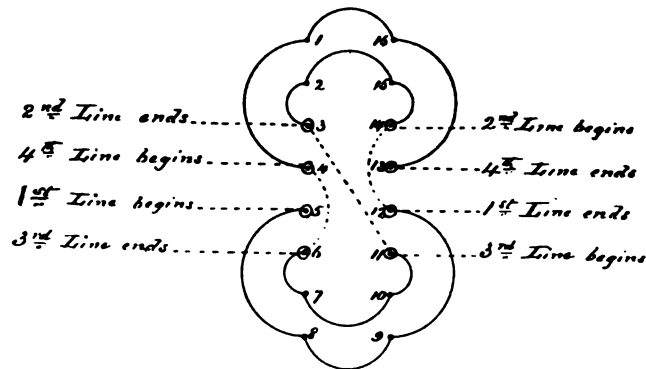


Fig. 4

for I make no question but you will readily allow the square of 16 to be the most magically magical of any magic square ever made by any magician.

I am etc.

B. F.

It will be seen that the squares shown in Figs. 1 and 2 are not perfect according to the rules of even magic squares previously given, but the interesting feature of their *bent diagonal columns* calls for more than passing notice. In order to facilitate the study of their construction, a 4×4 square is given in Fig. 3 which presents similar characteristics.

The dotted lines in this square indicate four bent diag-

onal columns, each of which has a total of 34; three of these columns being intact within the square and one being broken. Four bent diagonal columns may be formed from each of the four sides of the square, but only twelve

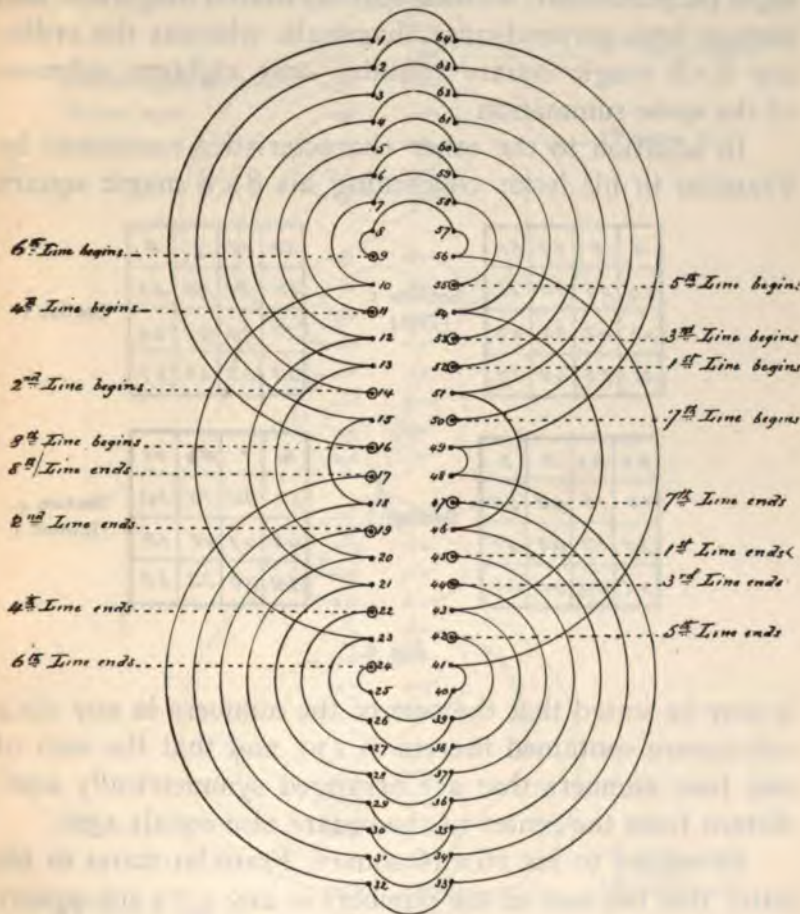


Fig. 5.

of these sixteen columns have the proper totals. Adding to these the eight straight columns, we find that this square contains twenty columns with summations of 34. The 4×4 "Jaina" square contains sixteen columns which sum

up to 34 while the ordinary 4×4 magic square contains only ten.

The 8×8 Franklin square (Fig. 1) contains forty-eight columns which sum up to 260, viz., eight horizontal, eight perpendicular, sixteen bent horizontal diagonals, and sixteen bent perpendicular diagonals, whereas the ordinary 8×8 magic square contains only eighteen columns of the same summation.

In addition to the other characteristics mentioned by Franklin in his letter concerning his 8×8 magic square

<table border="1"> <tr><td>5</td><td>8</td><td>57</td><td>60</td></tr> <tr><td>54</td><td>55</td><td>10</td><td>11</td></tr> <tr><td>43</td><td>42</td><td>23</td><td>22</td></tr> <tr><td>28</td><td>25</td><td>40</td><td>37</td></tr> </table>	5	8	57	60	54	55	10	11	43	42	23	22	28	25	40	37	Section 1. (Top.)	<table border="1"> <tr><td>59</td><td>58</td><td>7</td><td>6</td></tr> <tr><td>12</td><td>9</td><td>56</td><td>53</td></tr> <tr><td>21</td><td>24</td><td>41</td><td>44</td></tr> <tr><td>38</td><td>39</td><td>26</td><td>27</td></tr> </table>	59	58	7	6	12	9	56	53	21	24	41	44	38	39	26	27	Section 2.
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62	63	2	3																																
13	16	49	52																																
20	17	48	45																																
35	34	31	30																																
4	1	64	61																																
51	50	15	14																																
46	47	18	19																																
29	32	33	36																																

Fig. 6.

it may be stated that the sum of the numbers in any 2×2 sub-square contained therein is 130, and that the sum of any four numbers that are arranged symmetrically equidistant from the center of the square also equals 130.

In regard to his 16×16 square, Franklin states in his letter that the sum of the numbers in any 4×4 sub-square contained therein is 2056. The sub-division may indeed be carried still further, for it will be observed that the sum of the numbers in any 2×2 sub-square is 514, and there are also other curious features which a little study will disclose.

The Franklin Squares possess a unique and peculiar

symmetry in the arrangement of their numbers which is not clearly observable on their faces, but which is brought out very strikingly in their geometrical diagrams as given

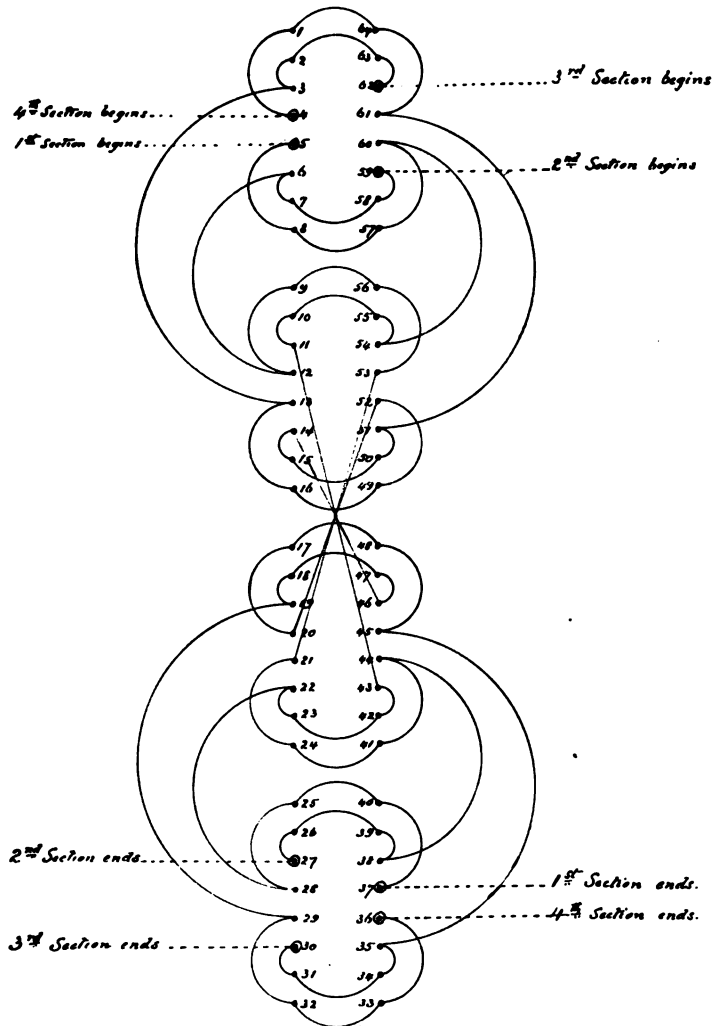


Fig. 7.

in Figs. 4 and 5, which illustrate respectively the diagrams of the 4×4 and 8×8 squares.

Magic cubes may be readily constructed by expanding these diagrams and writing in the appropriate numbers.

The cube of $4 \times 4 \times 4$ and its diagram are given as examples in Figs. 6 and 7, and it will be observed that the curious characteristics of the square are carried into the cube.

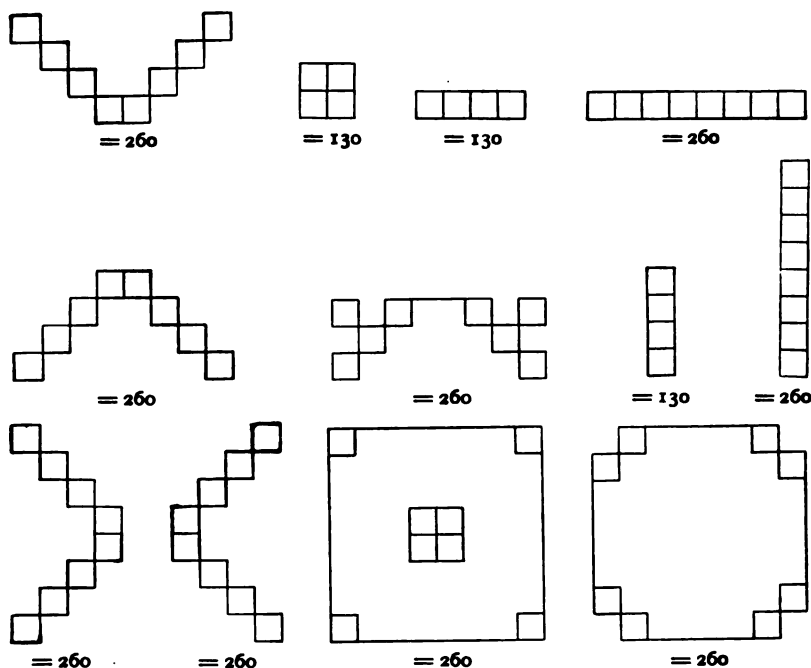
W. S. ANDREWS.

SCHENECTADY, May, 28, 1906.

CRITICISMS AND DISCUSSIONS.

THE FRANKLIN SQUARES AND OTHER MATHEMATICAL DIVERSIONS.

The July number of *The Monist* contained an article by C. A. Browne, of New Orleans, on "Magic Squares and Pythagorean



PROPERTIES OF FRANKLIN'S 8×8 SQUARE.

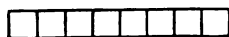
Numbers," in which he referred to Benjamin Franklin's interest in the subject. Upon inquiry I found in *The Life and Times of Benjamin Franklin*, by James Parton, (Vol. I, pp. 255-257), a brief

52	61	4	13	20	29	36	45
14	3	62	51	46	35	30	19
53	60	5	12	21	28	37	44
11	6	59	54	43	38	27	22
55	58	7	10	23	26	39	42
9	8	57	56	41	40	25	24
50	63	2	15	18	31	34	47
16	1	64	49	48	33	32	17

FRANKLIN 8×8 SQUARE.

200	217	232	249	8	25	40	57	72	89	104	121	136	153	168	185
58	39	26	7	250	231	218	199	186	167	154	135	122	103	90	71
198	219	230	251	6	27	38	59	70	91	102	123	134	155	166	187
60	37	28	5	252	229	220	197	188	165	156	133	124	101	92	69
201	216	233	248	9	24	41	56	73	88	105	120	137	152	169	184
55	42	23	10	247	234	215	202	183	170	151	138	119	106	87	74
203	214	235	246	11	22	43	54	75	86	107	118	139	150	171	182
53	44	21	12	245	236	213	204	181	172	149	140	117	108	85	76
205	212	237	244	13	20	45	52	77	84	109	116	141	148	173	180
51	46	19	14	243	238	211	206	179	174	147	142	115	110	83	78
207	210	239	242	15	18	47	50	79	82	111	114	143	146	175	178
49	48	17	16	241	240	209	208	177	176	145	144	113	112	81	80
196	221	228	253	4	29	36	61	68	93	100	125	132	157	164	189
62	35	30	3	254	227	222	195	190	163	158	131	126	99	94	67
194	223	226	255	2	31	34	63	66	95	98	127	130	159	162	191
64	33	32	1	256	225	224	193	192	161	160	129	128	97	96	65

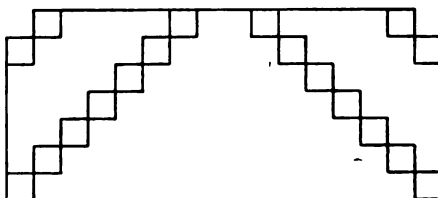
FRANKLIN 16×16 SQUARE.



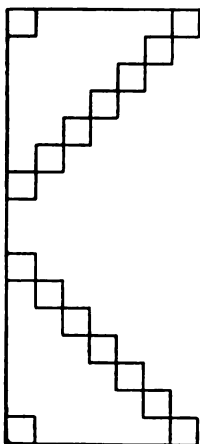
= 1028



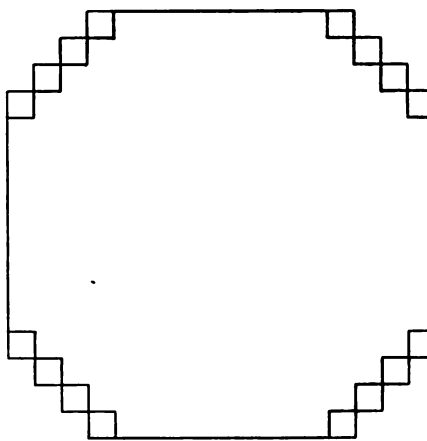
= 2056



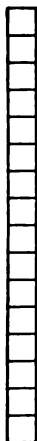
= 2056



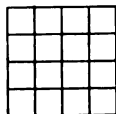
= 2056



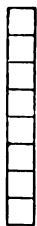
= 2056



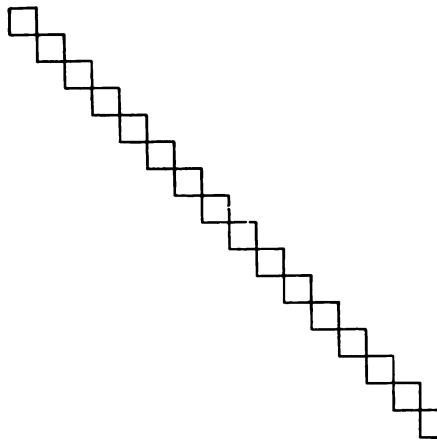
= 2056



= 2056



= 1028



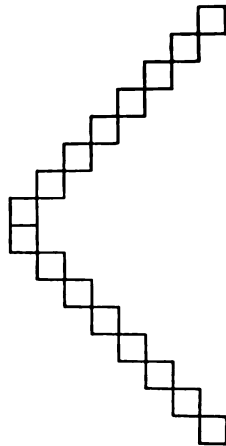
= 2056 - 128

PROPERTIES OF FRANKLIN'S 16×16 SQUARE.

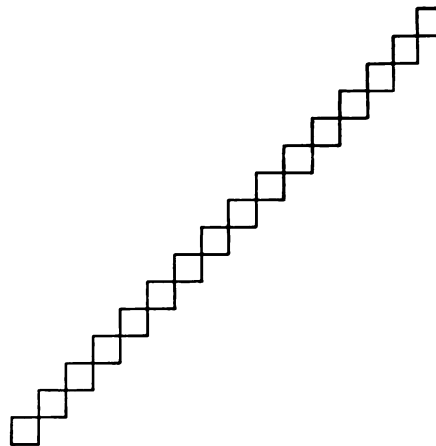
account of two magic squares, one 8×8 , the other 16×16 , both of which are here reproduced.

Mr. Parton explains the 8×8 square as follows:

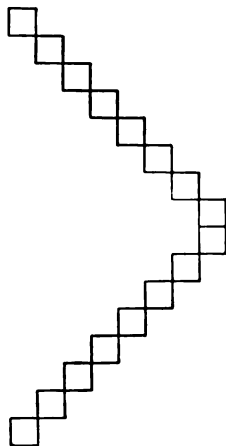
"This square, as explained by its contriver, contains astonishing



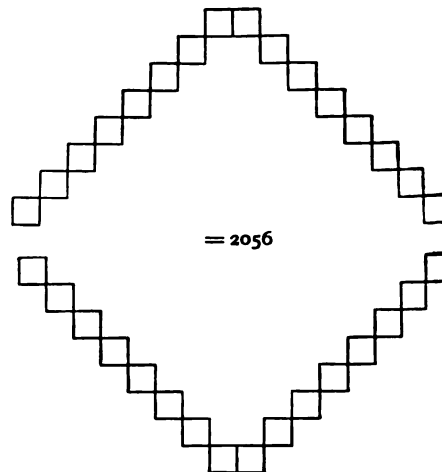
$= 2056$



$= 2056 + 128$



$= 2056$



$= 2056$

$= 2056$

PROPERTIES OF FRANKLIN'S 16×16 SQUARE.

(Continued from preceding page.)

"properties: every straight row (horizontal or vertical) added together makes 260, and each half row half 260. The bent row of "eight numbers ascending and descending diagonally, viz., from 16

"ascending to 10, and from 23 descending to 17, and every one of its parallel bent rows of eight numbers, makes 260. Also, the bent row from 52 descending to 54, and from 43 ascending to 45, and every one of its parallel bent rows of eight numbers, makes 260. Also, the bent row from 45 to 43, descending to the left, and from 23 to 17, descending to the right, and every one of its parallel bent rows of eight numbers, makes 260. Also, the bent row from 52 to 54, descending to the right, and from 10 to 16, descending to the left, and every one of its parallel bent rows of eight numbers, makes 260. Also, the parallel bent rows next to the above-mentioned, which are shortened to three numbers ascending and three descending, etc., as from 53 to 4 ascending and from 29 to 44 descending, make, with the two corner numbers, 260. Also, the two numbers, 14, 61, ascending, and 36, 19, descending, with the lower four numbers situated like them, viz., 50, 1, descending, and 32, 47, ascending, makes 260. And, lastly, the four corner numbers, with the four middle numbers, make 260.

"But even these are not all the properties of this marvelous square. Its contriver declared that it has 'five other curious ones,' which he does not explain; but which the ingenious reader may discover if he can."

These remarkable characteristics which Mr. Parton enumerates are illustrated graphically in the accompanying diagrams in which the relative position of the cells containing the numbers which make up the number 260, is indicated by the relation of the small hollow squares.

Franklin's 16×16 square is constructed upon the same principle as the smaller, and Mr. Parton continues:

"Nor was this the most wonderful of Franklin's magical squares. He made one of sixteen cells in each row, which besides possessing the properties of the squares given above (the amount, however added, being always 2056), had also this most remarkable peculiarity: a square hole being cut in a piece of paper of such a size as to take in and show through it just sixteen of the little squares, when laid on the greater square, the sum of sixteen numbers, so appearing through the hole, wherever it was placed on the greater square, should likewise make 2056."

The additional peculiarity which Mr. Parton notes of the 16×16 square is no more remarkable than the corresponding fact which is true of the smaller square, that the sum of the numbers in any

	1	2	3	4	5	6	7	8	
A	1	2	3	4	5	6	7	8	A
B	9	10	11	12	13	14	15	16	B
C	17	18	19	20	21	22	23	24	C
D	25	26	27	28	29	30	31	32	D
E	33	34	35	36	37	38	39	40	E
F	41	42	43	44	45	46	47	48	F
G	49	50	51	52	53	54	55	56	G
H	57	58	59	60	61	62	63	64	H
	1	2	3	4	5	6	7	8	

THE PLAN OF CONSTRUCTION.

A ₁	B ₈	C	D	E	F	G	H
H ₇	G ₂	F	E	D	C	B	A
3	6						
5	4						
5	4						
3	6						
7	2						
1	8						

First Step.

KEY TO THE SCHEME OF SIMPLE
ALTERNATION:-

A ₁	B ₈	C ₁	D ₈	E ₁	F ₈	G ₁	H ₈
H ₇	G ₂	F ₇	E ₂	D ₇	C ₂	B ₇	A ₂
A ₃	B ₆	C ₃	D ₆	E ₃	F ₆	G ₃	H ₆
H ₅	G ₄	F ₅	E ₄	D ₅	C ₄	B ₅	A ₄
A ₅	B ₄	C ₅	D ₄	E ₅	F ₄	G ₅	H ₄
H ₃	G ₆	F ₃	E ₆	D ₃	C ₆	B ₃	A ₆
A ₇	B ₂	C ₇	D ₂	E ₇	F ₂	G ₇	H ₂
H ₁	G ₈	F ₁	E ₈	D ₁	C ₈	B ₁	A ₈

Second Step.

COMPLETED SCHEME OF SIMPLE
ALTERNATION.

1	16	17	32	33	48	49	64
63	50	47	34	31	18	15	2
3	14	19	30	35	46	51	62
61	52	45	36	29	20	13	4
5	12	21	28	37	44	53	60
59	54	43	38	27	22	11	6
7	10	23	26	39	42	55	58
57	56	41	40	25	24	9	8

Third step.

8×8 MAGIC SQUARE CONSTRUCTED BY SIMPLE ALTERNATION.

2×2 combination of its cells yields 130. The properties of the larger square are also graphically represented here.

Franklin's squares were not known to me when I wrote my comments in the January number of *The Monist*; but at the first glance it became obvious that they belong to the same class as the Jaina square quoted by Professor David Eugene Smith (see *Monist* for January, 1906, p. 134), and that the clue to their construction must be sought in the same way.

We write down the numbers in numerical order and call the cells after the precedent of the chess-board, with two sets of symbols, letters and numbers. We call this "the plan of construction."

Before we construct the general scheme of Franklin's square we will build up another magic square, a little less complex in principle, which will be preparatory work for more complicated squares. We will simply intermix the ordinary series of numbers according to a definite rule alternately reversing the letters so that the odd rows are in alphabetical order and the even ones reversed. In order to distribute the numbers in a regular fashion so that no combination of letter and number would occur twice, we start with 1 in the upper left-hand corner and pass consecutively downwards, alternating between the first and second cells in the successive rows, thence ascending by the same method of simple alternation from 1 in the lower left-hand corner. We have now the key to a scheme for the distribution of numbers in an 8×8 magic square. It is the first step in the construction of the Franklin 8×8 magic square, and we call it "the key to the scheme of simple alternation."

It goes without saying that the effect would be the same if we begin in the same way in the right-hand corners,—only we must beware of a distribution that would occasion repetitions.

To complete the scheme we have to repeat the letters, alternately inverting their order row after row, and the first two given figures must be repeated throughout every row, as they are started. The top and bottom rows will read 1, 8; 1, 8; 1, 8; 1, 8. The second row from the top and also from the bottom will be 7, 2; 7, 2; 7, 2; 7, 2. The third row from the top and bottom will be 3, 6; 3, 6; 3, 6; 3, 6; and the two center rows 5, 4; 5, 4; 5, 4; 5, 4. In every line the sum of two consecutive figures yields 9. This is the second step, yielding the completed scheme of simple alternation.

The square is now produced by substituting for the letter and figure combinations, the corresponding figures according to the consecutive arrangement in the plan of construction.

Adding the results we find that all horizontal rows sum up to 20, while the vertical rows are alternately 200—1, and 200—4. The diagonal from the upper right to the lower left corner yields a sum of 20—12, while the other diagonal from the left upper corner terminating in the right lower corner makes 200—32. The upper values of the two diagonals total 200, and also the sum of the lower values, and the sum total of both diagonals is accordingly 40, or 2/20. The sum of the two left-hand half diagonals results in 20—16, and the sum of the two half diagonals to the right-hand side makes 20—31. The sum of the four central cells plus the four extreme corner cells yields also 200.

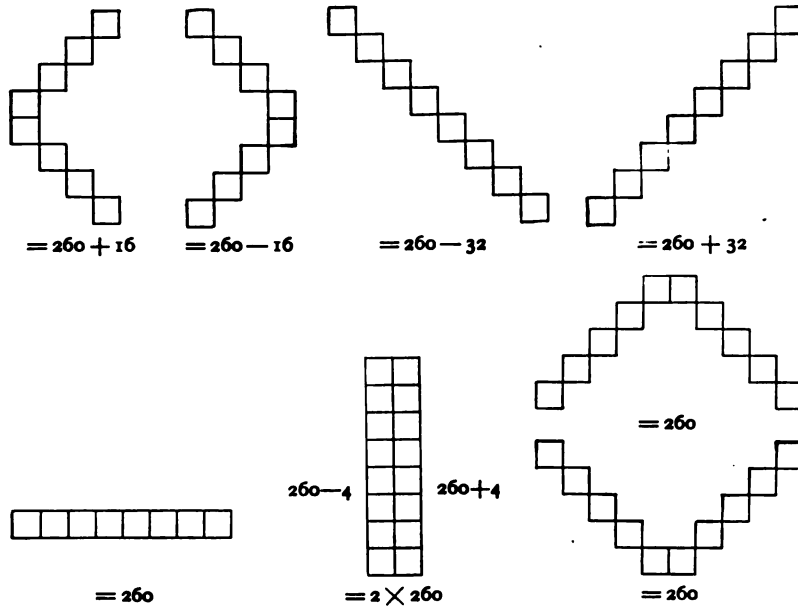
Considering the fact that the figures 1 to 3 of our scheme run up and down in alternate succession, we naturally have an arrangement of figures in which sets of two belong together. This bimatic peculiarity is evidenced in the result just stated, that the rows yield sums which are the same with an alternate addition and subtraction of an equal amount. So we have a symmetry which is astonishing and might be deemed magical, if it were not a matter of intrinsic necessity.

We represent these peculiarities in the adjoined diagrams which, however, by no means exhaust all the possibilities.

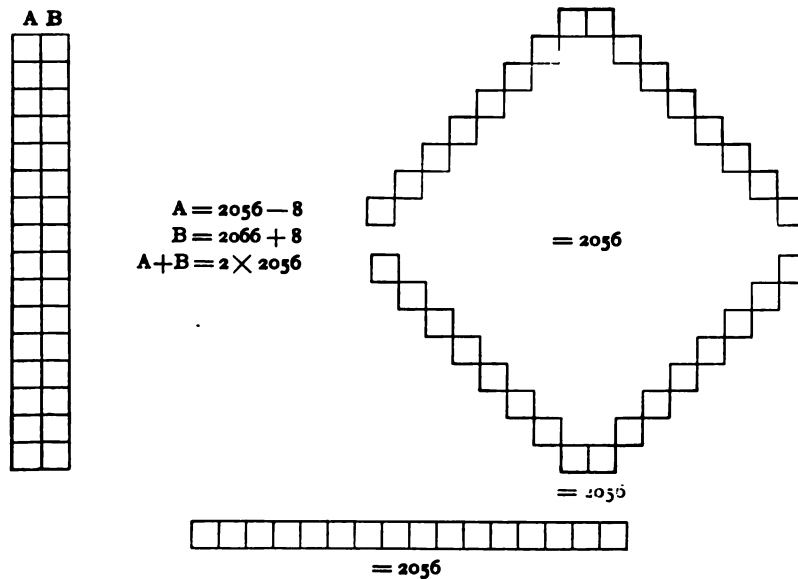
We must bear in mind that these magic squares are to be regarded as continuous; that is to say, they are as if their opposite sides in either direction passed over into one another as if they were joined both ways in the shape of a cylinder. In other words when we cross the boundary of the square on the right hand, the first row of cells outside to the right has to be regarded as identical with the first row of cells on the left; and in the same way the uppermost or first horizontal row of cells corresponds to the first row of cells below the bottom row. This remarkable property of the square will bring out some additional peculiarities which mathematicians may easily derive according to general principles; especially what was stated of the sum of the lower and upper half-diagonal of any bent series of cells running staircase fashion either upward or downward to the center, and hence proceeding in the opposite way to the other side.

The magic square constructed according to the method of simple alternation of figures is not, however, the square of Benjamin Franklin, but we can easily transform the former into the latter by slight modifications.

We notice that in certain features the sum total of the bent



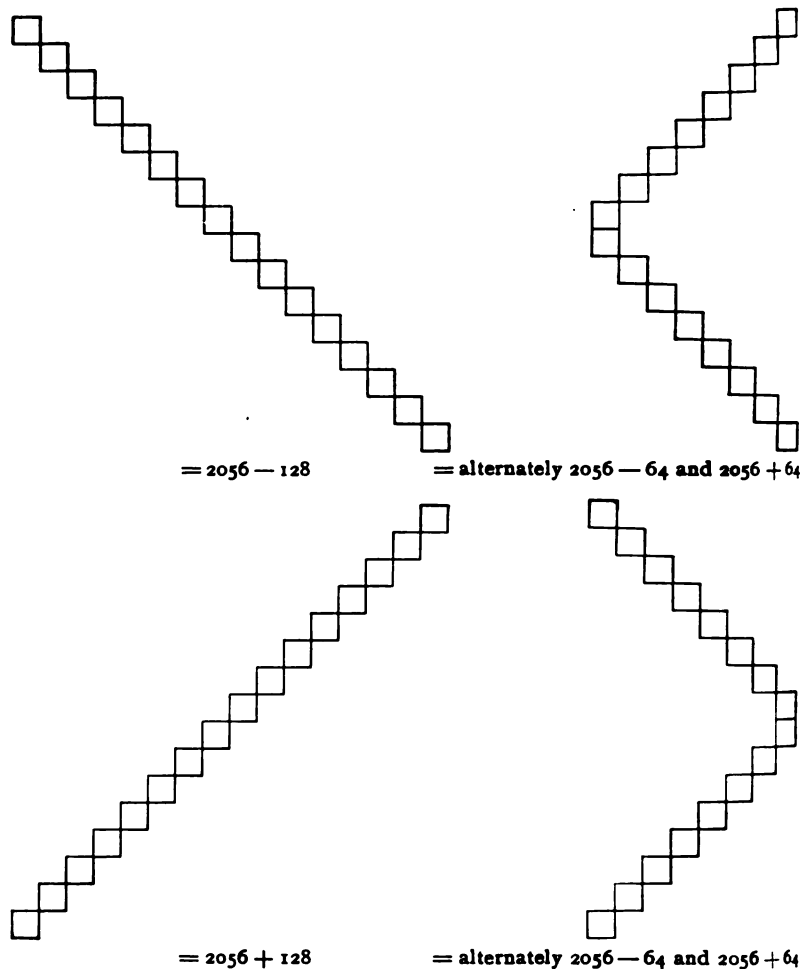
PROPERTIES OF 8×8 SQUARE BY SIMPLE ALTERNATION.



PROPERTIES OF 16×16 SQUARE BY SIMPLE ALTERNATION.

diagonals represents regularities which counterbalance one another on the right- and the left-hand side. In order to offset these results we have to shift the figures of our scheme.

We take the diagram which forms the key to the scheme of our



PROPERTIES OF 16×16 SQUARE BY SIMPLE ALTERNATION.

(Continued from preceding page.)

distribution by simple alternation, and cutting it in the middle, turn the lower half upside down, giving the first two rows as seen in the diagram in which the heavy lines indicate the cutting. Cutting then the upper half in two (i. e., in binate sections), and transposing

1	8
7	2
3	6
5	4
8	1
2	7
6	3
4	5

A ₁	B ₈	C	D	E	F	G	H
H ₇	G ₂	F	E	D	C	B	A
8	1						
2	7						
6	3						
4	5						
3	6						
5	4						

First Steps.

KEY TO THE SCHEME OF ALTERNATION WITH BINATE TRANSPOSITION.

A ₁	B ₈	C ₁	D ₈	E ₁	F ₈	G ₁	H ₈
H ₇	G ₂	F ₇	E ₂	D ₇	C ₂	B ₇	A ₂
A ₈	B ₁	C ₈	D ₁	E ₈	F ₁	G ₈	H ₁
H ₂	G ₇	F ₂	E ₇	D ₂	C ₇	B ₂	A ₇
A ₆	B ₃	C ₆	D ₃	E ₆	F ₃	G ₆	H ₃
H ₄	G ₅	F ₄	E ₅	D ₄	C ₅	B ₄	A ₅
A ₃	B ₆	C ₃	D ₆	E ₃	F ₆	G ₃	H ₆
H ₅	G ₄	F ₅	E ₄	D ₅	C ₄	B ₅	A ₄

Second Step.

SCHEME OF ALTERNATION WITH
BINATE TRANSPOSITION.

1	16	17	32	33	48	49	64
63	50	47	34	31	18	15	2
8	9	24	25	40	41	56	57
58	55	42	39	26	23	10	7
6	11	22	27	38	43	54	59
60	53	44	37	28	21	12	5
3	14	19	30	35	46	51	62
61	52	45	36	29	20	13	4

Third Step.

SQUARE CONSTRUCTED BY ALTERNA-
TION WITH BINATE TRANSPOSITION

G ₄	H ₅	A ₄	B ₅	C ₄	D ₅	E ₄	F ₅
B ₆	A ₃	H ₆	G ₃	F ₆	E ₃	D ₆	C ₃
G ₅	H ₄	A ₅	B ₄	C ₅	D ₄	E ₅	F ₄
B ₃	A ₆	H ₃	G ₆	F ₃	E ₆	D ₃	C ₆
G ₇	H ₂	A ₇	B ₂	C ₇	D ₂	E ₇	F ₂
B ₁	A ₈	H ₁	G ₈	F ₁	E ₈	D ₁	C ₈
G ₂	H ₇	A ₂	B ₇	C ₂	D ₇	E ₂	F ₇
B ₈	A ₁	H ₈	G ₁	F ₈	E ₁	D ₈	C ₁

SCHEME OF FRANKLIN'S 8×8 SQUARE.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	A
B	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	B
C	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	C
D	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	D
E	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	E
F	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	F
G	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	G
H	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	H
I	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	I
K	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	K
L	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	L
M	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	M
N	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	N
O	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	O
P	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	P
Q	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	Q
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	

CONSECUTIVE ARRANGEMENT OF NUMBERS IN A 16×16 SQUARE.

A ₁	B ₁₆	C	D	E	F	G	H	I	K	L	M	N	O	P	Q
O ₁₅	P ₂	O	N	M	L	K	I	H	G	F	E	D	C	B	A
3	14														
13	4														
5	12														
11	6														
7	10														
9	8														
9	8														
7	10														
11	6														
5	12														
13	4														
3	14														
15	2														
1	16														

KEY TO THE SCHEME OF SIMPLE ALTERNATION.

A ₁	B ₁₆	C ₁	D ₁₆	E ₁	F ₁₆	G ₁	H ₁₆	I ₁	K ₁₆	L ₁	M ₁₆	N ₁	O ₁₆	P ₁	Q ₁₆
Q ₁₅	P ₂	O ₁₅	N ₂	M ₁₅	L ₂	K ₁₅	I ₂	H ₁₅	G ₂	F ₁₅	E ₂	D ₁₅	C ₂	B ₁₅	A ₂
A ₃	B ₁₄	C ₃	D ₁₄	E ₃	F ₁₄	G ₃	H ₁₄	I ₃	K ₁₄	L ₃	M ₁₄	N ₃	O ₁₄	P ₃	Q ₁₄
Q ₁₃	P ₄	O ₁₃	N ₄	M ₁₃	L ₄	K ₁₃	I ₄	H ₁₃	G ₄	F ₁₃	E ₄	D ₁₃	C ₄	B ₁₃	A ₄
A ₅	B ₁₂	C ₅	D ₁₂	E ₅	F ₁₂	G ₅	H ₁₂	I ₅	K ₁₂	L ₅	M ₁₂	N ₅	O ₁₂	P ₅	Q ₁₂
Q ₁₁	P ₆	O ₁₁	N ₆	M ₁₁	L ₆	K ₁₁	I ₆	H ₁₁	G ₆	F ₁₁	E ₆	D ₁₁	C ₆	B ₁₁	A ₆
A ₇	B ₁₀	C ₇	D ₁₀	E ₇	F ₁₀	G ₇	H ₁₀	I ₇	K ₁₀	L ₇	M ₁₀	N ₇	O ₁₀	P ₇	Q ₁₀
Q ₉	P ₈	O ₉	N ₈	M ₉	L ₈	K ₉	I ₈	H ₉	G ₈	F ₉	E ₈	D ₉	C ₈	B ₉	A ₈
A ₉	B ₈	C ₉	D ₈	E ₉	F ₈	G ₉	H ₈	I ₉	K ₈	L ₉	M ₈	N ₉	O ₈	P ₉	Q ₈
Q ₇	P ₁₀	O ₇	N ₁₀	M ₇	L ₁₀	K ₇	I ₁₀	H ₇	G ₁₀	F ₇	E ₁₀	D ₇	C ₁₀	B ₇	A ₁₀
A ₁₁	B ₆	C ₁₁	D ₆	E ₁₁	F ₆	G ₁₁	H ₆	I ₁₁	K ₆	L ₁₁	M ₆	N ₁₁	O ₆	P ₁₁	Q ₆
Q ₅	P ₁₂	O ₅	N ₁₂	M ₅	L ₁₂	K ₅	I ₁₂	H ₅	G ₁₂	F ₅	E ₁₂	D ₅	C ₁₂	B ₅	A ₁₂
A ₁₃	B ₄	C ₁₃	D ₄	E ₁₃	F ₄	G ₁₃	H ₄	I ₁₃	K ₄	L ₁₃	M ₄	N ₁₃	O ₄	P ₁₃	Q ₄
Q ₃	P ₁₄	O ₃	N ₁₄	M ₃	L ₁₄	K ₃	I ₁₄	H ₃	G ₁₄	F ₃	E ₁₄	D ₃	C ₁₄	B ₃	A ₁₄
A ₁₅	B ₂	C ₁₅	D ₂	E ₁₅	F ₂	G ₁₅	H ₂	I ₁₅	K ₂	L ₁₅	M ₂	N ₁₅	O ₂	P ₁₅	Q ₂
Q ₁	P ₁₆	O ₁	N ₁₆	M ₁	L ₁₆	K ₁	I ₁₆	H ₁	G ₁₆	F ₁	E ₁₆	D ₁	C ₁₆	B ₁	A ₁₆

SCHEME OF SIMPLE ALTERNATION.

1	32	33	64	65	96	97	128	129	160	161	192	193	224	225	256
255	226	223	194	191	162	159	130	127	98	95	66	63	34	31	2
3	30	35	62	67	94	99	126	131	158	163	190	195	222	227	254
253	228	221	196	189	164	157	132	125	100	93	68	61	36	29	4
5	28	37	60	69	92	101	124	133	156	165	188	197	220	229	252
251	230	219	198	187	166	155	134	123	102	91	70	59	38	27	6
7	26	39	58	71	90	103	122	135	154	167	186	199	218	231	250
249	232	217	200	185	168	153	136	121	104	89	72	57	40	25	8
9	24	41	56	73	88	105	120	137	152	169	184	201	216	233	248
247	234	215	202	183	170	151	138	119	106	87	74	55	42	23	10
11	22	43	54	75	86	107	118	139	150	171	182	203	214	235	246
245	236	213	204	181	172	149	140	117	108	85	76	53	44	21	12
13	20	45	52	77	84	109	116	141	148	173	180	205	212	237	244
243	238	211	206	179	174	147	142	115	110	83	78	51	46	19	14
15	18	47	50	79	82	111	114	143	146	175	178	207	210	239	242
241	240	209	208	177	176	145	144	113	112	81	80	49	48	17	16

16×16 MAGIC SQUARE CONSTRUCTED BY SIMPLE ALTERNATION.

A ₁	B ₁₆	C	D	E	F	G	H	I	K	L	M	N	O	P	Q
Q ₁₅	P ₂	O	N	M	L	K	I	H	G	F	E	D	C	B	A
3	14														
13	4														
16	1														
2	15														
14	3														
4	13														
12	5														
6	11														
10	7														
8	9														
5	12														
11	6														
7	10														
9	8														

KEY TO THE SCHEME OF ALTERNATION WITH QUATERNATE TRANS POSITION.

A ₁	B ₁₆	C ₁	D ₁₆	E ₁	F ₁₆	G ₁	H ₁₆	I ₁	K ₁₆	L ₁	M ₁₆	N ₁	O ₁₆	P ₁	Q ₁₆
Q ₁₅	P ₂	Q ₁₅	N ₂	M ₁₅	L ₂	K ₁₅	I ₂	H ₁₅	G ₂	F ₁₅	E ₂	D ₁₅	C ₂	B ₁₅	A ₂
A ₃	B ₁₄	C ₃	D ₁₄	E ₃	F ₁₄	G ₃	H ₁₄	I ₃	K ₁₄	L ₃	M ₁₄	N ₃	O ₁₄	P ₃	Q ₁₄
Q ₁₃	P ₄	Q ₁₃	N ₄	M ₁₃	L ₄	K ₁₃	I ₄	H ₁₃	G ₄	F ₁₃	E ₄	D ₁₃	C ₄	B ₁₃	A ₄
A ₁₆	B ₁	C ₁₆	D ₁	E ₁₆	F ₁	G ₁₆	H ₁	I ₁₆	K ₁	L ₁₆	M ₁	N ₁₆	O ₁	P ₁₆	Q ₁
Q ₂	P ₁₅	Q ₂	N ₁₅	M ₂	L ₁₅	K ₂	I ₁₅	H ₂	G ₁₅	F ₂	E ₁₅	D ₂	C ₁₅	B ₂	A ₁₅
A ₁₄	B ₃	C ₁₄	D ₃	E ₁₄	F ₃	G ₁₄	H ₃	I ₁₄	K ₃	L ₁₄	M ₃	N ₁₄	O ₃	P ₁₄	Q ₃
Q ₄	P ₁₃	Q ₄	N ₁₃	M ₄	L ₁₃	K ₄	I ₁₃	H ₄	G ₁₃	F ₄	E ₁₃	D ₄	C ₁₃	B ₄	A ₁₃
A ₁₂	B ₅	C ₁₂	D ₅	E ₁₂	F ₅	G ₁₂	H ₅	I ₁₂	K ₅	L ₁₂	M ₅	N ₁₂	O ₅	P ₁₂	Q ₅
Q ₆	P ₁₁	Q ₆	N ₁₁	M ₆	L ₁₁	K ₆	I ₁₁	H ₆	G ₁₁	F ₆	E ₁₁	D ₆	C ₁₁	B ₆	A ₁₁
A ₁₀	B ₇	C ₁₀	D ₇	E ₁₀	F ₇	G ₁₀	H ₇	I ₁₀	K ₇	L ₁₀	M ₇	N ₁₀	O ₇	P ₁₀	Q ₇
Q ₈	P ₉	Q ₈	N ₉	M ₈	L ₉	K ₈	I ₉	H ₈	G ₉	F ₈	E ₉	D ₈	C ₉	B ₈	A ₉
A ₅	B ₁₂	C ₅	D ₁₂	E ₅	F ₁₂	G ₅	H ₁₂	I ₅	K ₁₂	L ₅	M ₁₂	N ₅	O ₁₂	P ₅	Q ₁₂
Q ₁₁	P ₆	Q ₁₁	N ₆	M ₁₁	L ₆	K ₁₁	I ₆	H ₁₁	G ₆	F ₁₁	E ₆	D ₁₁	C ₆	B ₁₁	A ₆
A ₇	B ₁₀	C ₇	D ₁₀	E ₇	F ₁₀	G ₇	H ₁₀	I ₇	K ₁₀	L ₇	M ₁₀	N ₇	O ₁₀	P ₇	Q ₁₀
Q ₉	P ₈	Q ₉	N ₈	M ₉	L ₈	K ₉	I ₈	H ₉	G ₈	F ₉	E ₈	D ₉	C ₈	B ₉	A ₈

SCHEME OF ALTERNATION WITH QUATERNATE TRANSPOSITION.

1	32	33	64	65	96	97	128	129	160	161	192	193	224	225	256
255	226	223	194	191	162	159	130	127	98	95	66	63	34	31	2
3	30	35	62	67	94	99	126	131	158	163	190	195	222	227	254
253	228	221	196	189	164	157	132	125	100	93	68	61	36	29	4
16	17	48	49	80	81	112	113	144	145	176	177	208	209	240	241
242	239	210	207	178	175	146	143	114	111	82	79	50	47	18	15
14	19	46	51	78	83	110	115	142	147	174	179	206	211	238	243
244	237	212	205	180	173	148	141	116	109	84	77	52	45	20	13
12	21	44	53	76	85	108	117	140	149	172	181	204	213	236	245
246	235	214	203	182	171	150	139	118	107	86	75	54	43	22	11
10	23	42	55	74	87	106	119	138	151	170	183	202	215	234	247
248	233	216	201	184	169	152	137	120	105	88	73	56	41	24	9
5	28	37	60	69	92	101	124	133	156	165	188	197	220	229	252
251	230	219	198	187	166	155	134	123	102	91	70	59	38	27	6
7	26	39	58	71	90	103	122	135	154	167	186	199	218	231	250
249	232	217	200	185	168	153	136	121	104	89	72	57	40	25	8

A SQUARE CONSTRUCTED BY ALTERNATION WITH QUATERNATE TRANSPOSITION.

N ₈	O ₉	P ₈	Q ₉	A ₈	B ₉	C ₈	D ₉	E ₈	F ₉	G ₈	H ₉	I ₈	K ₉	L ₈	M ₉
D ₁₀	C ₇	B ₁₀	A ₇	Q ₁₀	P ₇	O ₁₀	N ₇	M ₁₀	L ₇	K ₁₀	I ₇	H ₁₀	G ₇	F ₁₀	E ₇
N ₆	O ₁₁	P ₆	Q ₁₁	A ₆	B ₁₁	C ₆	D ₁₁	E ₆	F ₁₁	G ₆	H ₁₁	I ₆	K ₁₁	L ₆	M ₁₁
D ₁₂	C ₅	B ₁₂	A ₅	Q ₁₂	P ₅	O ₁₂	N ₅	M ₁₂	L ₅	K ₁₂	I ₅	H ₁₂	G ₅	F ₁₂	E ₅
N ₉	O ₈	P ₉	Q ₈	A ₉	B ₈	C ₉	D ₈	E ₉	F ₈	G ₉	H ₈	I ₉	K ₈	L ₉	M ₈
D ₇	C ₁₀	B ₇	A ₁₀	Q ₇	P ₁₀	O ₇	N ₁₀	M ₇	L ₁₀	K ₇	I ₁₀	H ₇	G ₁₀	F ₇	E ₁₀
N ₁₁	O ₆	P ₁₁	Q ₆	A ₁₁	B ₆	C ₁₁	D ₆	E ₁₁	F ₆	G ₁₁	H ₆	I ₁₁	K ₆	L ₁₁	M ₆
D ₅	C ₁₂	B ₅	A ₁₂	Q ₅	P ₁₂	O ₅	N ₁₂	M ₅	L ₁₂	K ₅	I ₁₂	H ₅	G ₁₂	F ₅	E ₁₂
N ₁₃	O ₄	P ₁₃	Q ₄	A ₁₃	B ₄	C ₁₃	D ₄	E ₁₃	F ₄	G ₁₃	H ₄	I ₁₃	K ₄	L ₁₃	M ₄
D ₃	C ₁₄	B ₃	A ₁₄	Q ₃	P ₁₄	O ₃	N ₁₄	M ₃	L ₁₄	K ₃	I ₁₄	H ₃	G ₁₄	F ₃	E ₁₄
N ₁₅	O ₂	P ₁₅	Q ₂	A ₁₅	B ₂	C ₁₅	D ₂	E ₁₅	F ₂	G ₁₅	H ₂	I ₁₅	K ₂	L ₁₅	M ₂
D ₁	C ₁₆	B ₁	A ₁₆	Q ₁	P ₁₆	O ₁	N ₁₆	M ₁	L ₁₆	K ₁	I ₁₆	H ₁	G ₁₆	F ₁	E ₁₆
N ₄	O ₁₃	P ₄	Q ₁₃	A ₄	B ₁₃	C ₄	D ₁₃	E ₄	F ₁₃	G ₄	H ₁₃	I ₄	K ₁₃	L ₄	M ₁₃
D ₁₄	C ₃	B ₁₄	A ₃	Q ₁₄	P ₃	O ₁₄	N ₃	M ₁₄	L ₃	K ₁₄	I ₃	H ₁₄	G ₃	F ₁₄	E ₃
N ₂	O ₁₅	P ₂	Q ₁₅	A ₂	B ₁₅	C ₂	D ₁₅	E ₂	F ₁₅	G ₂	H ₁₅	I ₂	K ₁₅	L ₂	M ₁₅
D ₁₆	C ₁	B ₁₆	A ₁	Q ₁₆	P ₁	O ₁₆	N ₁	M ₁₆	L ₁	K ₁₆	I ₁	H ₁₆	G ₁	F ₁₆	E ₁

SCHEME OF FRANKLIN'S 16×16 SQUARE.

the second quarter to the bottom, we have the key to the entire arrangement of figures; in which the alternation starts as in the scheme for simple alternation but skips the four center rows passing from 2 in the second cell of the second row to 3 in the first cell of the seventh, and from 4 in the second cell of the eighth passing to 5 in the first cell, and thence upwards in similar alternation, again passing over the four central rows to the second and ending with 8 in the second cell of the first row. Then the same alternation is produced in the four center rows. It is obvious that this can not start in the first cell as that would duplicate the first row, so we start with 1 in the second cell passing down uninterruptedly to 4 and ascending as before from 5 to 8.

A closer examination will show that the rows are binate, which means in sets of two. The four inner numbers, 3, 4, 5, 6 and the two outer sets of two numbers each, 1, 2 and 7, 8, are brought together thus imparting to the whole square a binate character.

We are now provided with a key to build up a magic square after the pattern of Franklin. We have simply to complete it in the same way as our last square repeating the letters with their order alternately reversed as before, and repeating the figures in each line.

When we insert their figure values we have a square which is not the same as Franklin's, but possesses in principle the same qualities.

To make our 8×8 square of binate transposition into the Franklin square we must first take its obverse square; that is to say, we preserve exactly the same order but holding the paper with the figures toward the light we read them off from the obverse side, and then take the mirror picture of the result, holding the mirror on either horizontal side. So far we have still our square with the peculiarities of our scheme, but which lacks one of the incidental characteristics of Franklin's square. We must notice that he makes four cells in both horizontal and vertical directions sum up to 130 which property is necessarily limited only to two sets of four cells in each row. If we write down the sum of $1+2+3+4+5+6+7+8=2 \times 18$, we will find that the middle set $3+4+5+6$ is equal to the rest consisting of the sum of two extremes, $1+4$, and $7+8$. In this way we cut out in our scheme of symbols, the rows represented by the letters C, D, E, F in either order and accordingly we can shift either of the two first or two last vertical rows to the other side. Franklin did the former, thus beginning

his square with G_4 in the left upper corner. We have indicated this division by heavier lines in both schemes.

The greater square of Franklin, which is 16×16 , is made after the same fashion, and the adjoined diagrams will sufficiently explain its construction.

We do not know the method employed by Franklin; we possess only the result, but it is not probable that he derived his square according to the scheme employed here.

Our 16×16 square is not exactly the same as the square of Franklin, but it belongs to the same class. Our method gives the key to the construction, and it is understood that the system here represented will allow us to construct many more squares by simply pushing the square beyond its limits into the opposite row which by this move has to be transferred.

There is the same relation between Franklin's 16×16 square and our square constructed by alternation with quaternate transposition, that exists between the corresponding 8×8 squares.

* * *

Mr. C. A. Browne, Jr. furnishes another interesting square of 27×27 representing in addition to its arithmetical qualities commonly possessed by magic squares some ulterior significance of our calendar system referring to the days of the month as well as the days of the year and cycles of years. It is wonderful, and at first sight mystifying, to observe how the course of nature reflects even to intricate details the intrinsic harmony of mathematical relations; and yet when we consider that nature and pure thought are simply the result of conditions first laid down and then consistently carried out in definite functions of a distinct and stable character, we will no longer be puzzled but understand why science is possible, why man's reason contains the clue to many problems of nature and, generally speaking, why reason with all its wealth of *a priori* thoughts can develop at all in a world that at first sight seems to be a mere chaos of particular facts. The purely formal relations of mathematics, materially considered mere nonentities, constitute the bond of union which encompasses the universe, stars as well as motes, the motions of the Milky Way not less than the minute combinations of chemical atoms, and also the construction of pure thought in man's mind.

Mr. Browne's square is of great interest to Greek scholars because it throws light on an obscure passage in Plato's Republic, re-

ferring to a magic square the center of which is 365, the number of days in a year.

The construction of Mr. Browne's square is based upon the simplest square of odd numbers which is 3×3 . But it becomes somewhat complicated by being extended to three in the third power which is 27. Odd magic squares are, as we remember, built up by a progression in staircase fashion, but since those numbers

352	381	326	439	468	413	274	303	248	613	642	587	700	729	674	535	564	509	118	47	92	205	234	75	40	55	14
327	353	379	414	440	466	249	275	301	588	614	640	676	701	727	510	536	562	93	119	145	180	206	232	15	41	51
380	325	354	467	412	441	302	247	276	641	686	615	728	673	702	583	508	537	146	91	120	253	178	237	88	42	42
277	306	251	385	384	329	433	462	407	538	567	512	616	645	590	694	723	668	43	72	17	121	150	95	95	228	72
352	278	304	330	356	382	408	434	460	513	539	565	591	617	643	669	695	721	18	44	70	96	122	148	174	200	226
305	250	279	383	328	357	461	405	435	568	511	540	644	589	618	722	667	696	71	16	45	149	34	123	227	173	21
438	465	410	271	300	245	358	387	332	697	726	671	532	561	606	612	648	593	202	231	176	37	66	17	124	53	88
411	437	463	246	273	298	323	359	385	672	698	724	597	533	559	684	610	646	177	203	229	12	38	64	99	125	151
464	433	438	299	244	273	386	331	360	725	670	699	560	505	534	647	592	621	230	75	204	65	10	35	152	97	126
127	156	101	214	243	188	49	78	23	381	390	335	448	477	422	283	312	267	395	324	569	682	711	656	517	546	491
102	128	164	189	215	241	24	50	76	336	382	388	423	449	475	250	284	310	570	555	622	557	683	709	482	518	544
155	100	129	242	187	216	27	22	51	389	334	363	476	421	450	311	256	285	621	568	597	710	655	684	545	490	519
52	81	26	130	160	194	208	237	182	385	315	365	384	393	338	442	471	416	500	549	484	598	627	572	678	706	650
27	53	73	105	131	157	183	209	235	261	287	313	339	365	391	417	443	469	495	521	547	573	599	625	651	677	703
80	25	54	158	103	132	236	181	210	314	259	288	392	337	366	470	415	444	548	493	522	626	571	500	704	649	678
211	240	185	46	75	20	133	162	107	445	474	419	280	309	254	367	396	341	713	708	653	514	543	488	601	630	575
186	212	238	21	47	73	108	134	160	421	446	472	255	281	307	342	368	394	654	590	706	483	515	541	576	602	628
239	184	213	74	15	48	161	106	135	473	418	447	306	253	282	395	340	369	717	652	681	542	487	516	629	574	603
604	532	578	581	720	665	526	555	500	195	138	93	196	225	170	21	60	15	370	299	344	457	486	431	292	321	266
578	605	631	686	592	719	571	527	553	84	119	136	17	197	223	6	32	58	345	371	397	432	458	484	257	283	313
632	577	606	715	664	593	554	499	528	127	82	117	224	169	198	59	4	73	398	343	372	485	430	459	320	265	294
329	559	582	607	536	581	695	714	655	34	63	8	112	141	96	190	219	164	235	224	269	373	462	347	451	480	465
584	530	559	582	608	534	660	586	712	9	36	3	87	113	139	165	191	217	270	295	322	346	374	400	426	452	478
537	582	531	635	540	609	713	658	587	82	7	36	110	85	114	218	163	192	323	268	297	401	346	375	479	494	455
688	717	682	522	552	487	618	533	584	93	222	167	26	57	2	115	144	89	464	483	428	283	318	263	378	455	360
582	680	715	488	524	560	585	611	637	168	134	210	3	29	55	90	116	142	429	465	441	284	290	316	351	377	403
716	687	620	551	486	525	638	583	612	22	168	135	56	1	38	142	88	117	482	427	456	317	282	257	484	545	375

THE MAGIC SQUARE OF MR. C. A. BROWNE.

that fall outside the square have to be transferred to their corresponding places inside, the first and last staircases are changed into the knight's move of the chessboard, and only the middle one retains its original staircase form. We must construct the square so that the central figure, which in a 3×3 square is 5, must always fall in the central cell. Accordingly, we must start the square

beginning with figure 1 outside of the square in any middle cell immediately bordering upon it, which gives four starting-points from which we may either proceed from the right or the left, either upwards or downwards which yields eight possibilities of the 3×3 square. For the construction of his 27×27 square, Mr. Browne might have taken any of these eight possibilities as his pattern. He selected the one starting on the top of the square and moving toward the right, and thus he always follows the peculiar arrangement of this particular square. It is the fourth in our adjoined diagrams of the 3×3 squares. Any one who will take the trouble to trace the regular succession of Mr. Browne's square will find that it is a constant repetition of the knight's move, the staircase move

3			7			1			1				
1	2	7	6	9	1	4	3	8	9	3	7	2	
	9	5	1			9	9	5			1	7	3
	4	3	8			3	2	7			6	9	6
7			3			9			9				

7			3			9			9				
9	8	3	4	1	9	6	7	2	1	3	7	2	
	1	5	9			1	1	5			9	7	2
	6	7	2			3	8	3			4	1	6
3			7			1			1				

THE EIGHT POSSIBLE ARRANGEMENTS OF THE 3×3 MAGIC SQUARE.

and again a knight's move on a small scale of 3×3 which is repeated on a larger scale 9×9 , thus leading to the wonderful regularity which, according to Mr. Browne's interpretation of Plato, astonished the sages of ancient Greece.

Any one who discovers at random some magic square with its immanent harmony of numbers, is naturally impressed by its apparent occult power, and so it happens that they were deemed supernatural and have been called "magic." They seem to be the product of some secret intelligence and to contain a message of ulterior meaning. But if we have the key to their regularity we know that the harmony that pervades them is necessary and intrinsic.

Nor is the regularity limited to magic squares. There are other number combinations which exhibit surprising qualities, and I will here select a few striking cases.

If we write down all the nine figures in ascending and descending order we have a number which is equal to the square of a number consisting of the figure 9 repeated 9 times, divided by the sum of an ascending and descending series of all the figures thus:

$$12345678987654321 = \frac{99999999 \times 99999999}{1+2+3+4+5+6+7+8+9+8+7+6+5+4+3+2+1}.$$

The secret of this mysterious coincidence is that $11 \times 11 = 121$; $111 \times 111 = 12321$; $1111 \times 1111 = 1234321$, etc., and a sum of an ascending or a descending series which starts with 1 is always equal to the square of its highest number. $1+2+1=2 \times 2$; $1+2+3+4+3+2+1=4 \times 4$, etc., which we will illustrate by one more instance of the same kind, as follows:

$$1234567654321 = \frac{777777 \times 777777}{1+2+3+4+5+6+7+6+5+4+3+2+1}.$$

There are more instances of numerical regularities.

All numbers consisting of six equal figures are divisible by 7, and also, as a matter of course, by 3 and 11, as indicated in the following list:

$$\begin{aligned} 111111:7 &= 15873 \\ 222222:7 &= 31746 \\ 333333:7 &= 47619 \\ 444444:7 &= 63492 \\ 555555:7 &= 79365 \\ 666666:7 &= 95238 \\ 777777:7 &= 111111 \\ 888888:7 &= 126984 \\ 999999:7 &= 142857 \end{aligned}$$

Finally we will offer two more strange coincidences of a *lusus numerorum*.

$$\begin{aligned} 0 \times 9 + 1 &= 1 \\ 1 \times 9 + 2 &= 11 \\ 12 \times 9 + 3 &= 111 \\ 123 \times 9 + 4 &= 1111 \\ 1234 \times 9 + 5 &= 11111 \\ 12345 \times 9 + 6 &= 111111 \\ 123456 \times 9 + 7 &= 1111111 \\ 1234567 \times 9 + 8 &= 11111111 \\ 12345678 \times 9 + 9 &= 111111111 \\ 123456789 \times 9 + 10 &= 1111111111. \end{aligned}$$

$$\begin{aligned}
 1 \times 8 + 1 &= 9 \\
 12 \times 8 + 2 &= 98 \\
 123 \times 8 + 3 &= 987 \\
 1234 \times 8 + 4 &= 9876 \\
 12345 \times 8 + 5 &= 98765 \\
 123456 \times 8 + 6 &= 987654 \\
 1234567 \times 8 + 7 &= 9876543 \\
 12345678 \times 8 + 8 &= 98765432 \\
 123456789 \times 8 + 9 &= 987654321.
 \end{aligned}$$

No wonder that such strange regularities impress the human mind. A man who knows only the externality of these results will naturally be inclined toward occultism. The world of numbers as much as the actual universe is full of regularities which can be reduced to definite rules and laws giving us a key that will unlock their mysteries and enable us to predict certain results under definite conditions. Here is the key to the significance of the *a priori*.

Mathematics is a purely mental construction, but its composition is not arbitrary. On the contrary it is tracing the results of our own doings and taking the consequences of the conditions we have created. Though the scope of our imagination with all its possibilities be infinite, the results of our construction are definitely determined as soon as we have laid their foundation, and the actual world is simply one realization of the infinite potentialities of being. Its regularities can be unraveled as surely as the harmonic relations of a magic square.

Facts are just as much determined as our thoughts, and if we can but gain a clue to their formation we can solve the problem of their nature, and are enabled to predict their occurrence and sometimes even to adapt them to our own needs and purposes.

A study of magic squares may have no practical application, but an acquaintance with them will certainly prove useful, if it were merely to gain an insight into the fabric of regularities of any kind.

EDITOR.

HAECKEL'S THESES. A PROTEST.

Though I feel happy to belong to those of whom Ernst Haeckel says that the clear insight into the evolution of the world not only satisfies the causal feeling of their reason,* but even their highest emotional cravings, I, on the other hand, quite agree with the great German naturalist that for most educated people of our time monism is destined to be the connecting link between religion and science, and I much appreciate his theses for the organization of monism.

Now I should like to make a few remarks concerning the criticism upon those theses in the January number of *The Monist* (Vol XVI, pp. 120-123), as it has roused my contradiction in several points.

First of all, when looking again through the German text of the theses, I am unable to find that their formulation is "slovenly, and made without due precaution." I should call it clear and uncompromising. And that is what is wanted in our present time, where in most countries a lukewarm tendency is shown in science as well as in politics to reconcile two irreconcilable principles: papism and free thought and teaching.

Further, as regards Kant's doctrine of the *a priori* there is, in my opinion, nothing astonishing that he should reject it, who does not believe in apriorism.

I also can not understand will to be free, when it can not "will as it pleases," and I, therefore, accept determinism in the sense of Haeckel and Paul Rée. Nor can I help, after many years of biological studies, taking it for an established fact that man is nothing else but a social animal most likely descended from one common ancestor with the now living anthropoid apes. When speaking about man, we have not only to think of the highly cultured *homo sapiens* "with all his wealth of moral ideals and scientific attainment," but also of the savage man, who mentally is more closely allied to the ape than, for instance, the critic of Haeckel's theses.

Furthermore, to the best of my knowledge, Ernst Haeckel never disregards in his works the evolutionary phase in religion and science, but he naturally feels no sympathy with the past, where it wilfully hampered the progress of science. The fetishism in Central Africa and in the Celestial Empire did and does, on the

* Undoubtedly our correspondent here has in mind Schopenhauer's phrase so difficult to translate into English: "Das Causalbedürfniss befriedigen."

other hand, very little, if at all, impede Western civilization, and needed, therefore, not to be mentioned by Professor Haeckel together with the Christian superstitions, nor was there for the same reason any necessity for the courageous philosopher of Jena to denounce the "wild theories" alluded to in the article under review.

PAUL VON RAUTENFELD.

SWATOW, CHINA.

EDITORIAL REPLY.

We take pleasure in publishing Herrn von Rautenfeld's protest against our criticism of Professor Haeckel's theses. It proves that our monistic friend of Jena has staunch supporters all over the world, even in Swatow of distant China, but having read Herrn von Rautenfeld's arguments we do not feel compelled to change our views. The Editor of *The Monist* is a personal friend of Professor Haeckel, but the cause of monism would not be well served if for the sake of politeness he would abstain from criticism and avoid controversy.

In former numbers we have discussed our differences with Professor Haeckel, and there is no need of repeating them.* Be it sufficient here to state that we deem these differences of great importance because their recognition would prevent monism from being narrowed down to a onesided partisan issue, and we feel convinced that Professor Haeckel himself would accept our view if we could have a quiet hour's talk with him.

A LETTER FROM PROFESSOR MACH.

The July number of *The Monist* contained an editorial article on "Professor Mach's Philosophy" written in reply to Dr. Hans Kleinpeter's essay "On the Monism of Professor Mach," which appeared in the April number. Dr. Kleinpeter in his enthusiasm for the master whose lead he follows had been carried away in some of his statements to such an extent as to render Professor Mach's

* "Professor Haeckel's Monism and the Ideas of God and Immortality," *The Open Court*, V, 2957 (Sept. 17, 1891); "Professor Haeckel's Confession of Faith," *The Open Court*, VII, 3529 (Jan. 1893); "Monism not Mechanicism," *The Monist*, II, 438; "Professor Haeckel's Monism," *The Monist*, II, 598; "Theology as a Science," *The Monist*, XIII, 24; "Haeckel's Theses for a Monistic Alliance," *The Monist*, XVI, 120.

views and way of treating problems the final authority in matters philosophical, to the exclusion of all others, criticizing among them also the monism of *The Monist*. The editor not without reluctance undertook to answer Professor Kleinpeter's claims and uphold his own views in face of the new orthodoxy that was put up by this able disciple of one of our most prominent leaders in modern philosophy. We trust that our readers felt that the criticism necessarily implied in our comments should not be taken as any lack of appreciation for a man whose merits in science and philosophy are unquestioned in the world of contemporaneous thought, and we cherish Professor Mach's friendship not only for the sake of his scientific accomplishments, but also for the amiable spirit with which he deals with all questions of a personal nature. Nothing can be more characteristic of the simple modesty of his nature than the letter which he wrote the Editor after the perusal of the two articles. We publish it here in the original German as it would lose many of the fine points in an English translation.

"Hochgeehrter Herr und Freund!

"Die Artikel im *Monist*, April und Juli, habe ich gelesen. Ich bin Ihnen sehr dankbar, dass Sie gedämpft haben. Uebertreibungen können nur unangenehm empfunden werden.

"Ich habe vom Boden meiner Spezialwissenschaft aus einzelne Motive der Methode klar gelegt. Darin bin ich nicht einmal allein, wie ich oft genug hervorgehoben habe. Stallo, Avenarius, Schuppe und wahrscheinlich noch viele andere haben mitgewirkt. Eine abgeschlossene Philosophie habe ich nie gegeben und auch nie beabsichtigt. Darum ist es auch nicht meine Sache, andere Philosophen zu kritisieren. Darum, weil ich einige Sätze vertrete, behaupte ich noch nicht, dass von andern vertretene Thesen wertlos oder unrichtig sind.

"Augenblicklich sehr beschäftigt, sende ich Ihnen eine kleine Ausführung unter Kreuzband, aus welcher Sie sehen, wie wenig ich für mich in Anspruch nehme, und wie sehr ich bemüht bin, den Zusammenhang meiner Gedanken mit älteren aufzuzeigen.

"Einstweilen in ausgezeichnete Hochachtung Ihr ergebenster

"DR. ERNST MACH."

"WIEN, 17 Juli 1906."

There is one point in Professor Mach's letter to which I must take exception, and it is the very thing for which he thanks me so

kindly. Professor Mach is under the impression that I reduce the exaggerated praise of Dr. Kleinpeter, and so he expresses his recognition for the damper I put on it, but this is not so. It was not my intention to detract from Professor Mach's fame and greatness, for I believe that I appreciate his worth as much as does Dr. Kleinpeter; and lest others may have read my article in this sense, I will state here publicly that my admiration for Professor Mach can not be less than that of his most ardent disciple and follower. My intention in writing the article on "Professor Mach's Philosophy" was simply to correct a few errors, or what I deemed to be errors, of Dr. Kleinpeter in his statement of Professor Mach's position, as well as my own relation to it. He did not see that in many points I hold exactly or at least approximately the same views, and it is this kinship between us which has so strongly attracted my attention to Professor Mach's writings. That I do not agree in some other points with Professor Mach is true, but even a statement of that difference will not be regarded as an attempt to lower Professor Mach in the opinion of our readers, or minimize his significance in the scientific world. If Dr. Kleinpeter had made this statement in some other publication, I would not have deemed it necessary to make a reply, but having made it in *The Monist*, it was naturally a puzzle to our readers why I allowed it to go unchallenged, and it appeared like an admission. Moreover, a ventilation of the most important philosophical questions and differences with prominent thinkers can only be beneficial, and we have ventured into the discussion because we were confident that Professor Mach would not misconstrue our answer to Kleinpeter, as implying an attack upon himself.

PAUL CARUS.

THREE AND A FRACTION.

Prof. Enno Littmann, of Princeton, New Jersey, who has recently been called to the chair of Coptic and Abyssinian at the University of Strassburg, with reference to an editorial article on "The Number π in Christian Prophecy," in the last *Monist*, informs us that there is at present a belief among the Arabs "that the food a man eats stays with him three days and a third."

"A foreigner who comes as a guest to a table (perhaps even a hostile one)," Professor Littmann continues, "is safe for three days and a third after he has eaten from the bread of that tribe. If I am the guest of an Arab tribe and have eaten their food, then

go away, nobody of that tribe may harm me for three and a third days; but after that time even my host may attack and rob me. From this belief also another custom is derived, viz., to let any foreigner stay as a guest for three and a third days.

"When Paul says, 'on the third day,' who knows whether he did not exactly mean Tuesday, for in the Eastern languages of to-day, Tuesday is called 'Third-day' (as Sunday 'First-day,' Monday 'Second-day,' etc.)? But I do not know just now how old this nomenclature is in the Semite languages. However, 'First-day' for Sunday occurs in the New Testament. By the way the Abyssinians celebrate both Saturday ('small Sabbath') and Sunday ('great Sabbath')."

BOOK REVIEWS AND NOTES.

THE CODE OF HAMMURABI. By Robert Francis Harper, Ph.D. Chicago: The University Press. Callaghan & Co. London: Luzac & Co., 1904.

All students of Babylonian inscriptions as well as of theology and law will be most grateful to Professor Harper for having given us a book which embodies in it not only a quite careful transliteration and translation of this now most celebrated code of laws, but which gives us also a pretty complete and comprehensive "Index of Subjects," a "List of Proper Names," a "Glossary, and last but not least the "Original" of the code itself. To the "Original" again are added a "List of Signs," a "List of Scribal Errors," a "List of Erasures," and a map of Hither Asia. The student thus finds in this volume all that is necessary for a deeper study and appreciation of this venerable document.

We must not, however, expect the book before us to be a *final* edition of either the original text itself or of its transliteration or translation. Says Professor Harper himself: "The text as represented in Plates I—LXXXII has been reconstructed and edited from the photographs published by Scheil in Tome IV, *Textes Elamites-Sémitiques* of the *Mémoires de la Délégation en Perse*, Paris: Leroux, 1902;" and again: "I am of opinion that an edition of an Assyrian or Babylonian text which is to be final must go back to the originals." (Introduction, pp. xii, xiii.) All that this edition is intended for is to put into the hands of students the laws of Hammurabi in a convenient and handy form. That Professor Harper has succeeded in his task most admirably nobody can or will deny; and I am certain all students will be grateful to him for such a convenient edition.

It is not my intention to go into a detailed criticism of this useful book—that would be out of place and would lead too far. A few remarks, however, may be permitted here:

The transcription is not carried through according to uniform rules; thus e. g. there is no distinction made between the different kinds of *u* or *shu* or *gi*, etc., etc., nor is the same word uniformly transcribed, as e. g. *ilu* EN-LIL I, 3. 46. 53 etc., but *ilu Bêl* in XL, 12. 64; XLII, 53. 89. 95; XLIV, 86 and *ilu bêlu-ut* for *ilu* EN-LIL-ut I, ii. Sometimes we have two different kinds of transcription for the same word, thus *Dur-ilu-KI* in I, 59 is given as *Dûr-ilu* in the List of Proper Names, where it is said to be a city! This, no doubt, must be a printer's error, for surely Professor Harper would know that *Dûr-ilu* the city where god Kadi was supreme (*Early Babyl. Hist.*, p. 255) is written quite differently, viz. BAD=*dûru* wall, while we have here the

sign DUR=*riksu*=band. This name must be transcribed not *Dur-ilu-KI* but *Dur-an-ki*; nor is it a city, but one of the names of the zigurrat of *E-kur*, the temple of Enlil of Nippur. (See my "Bel, the Christ of Ancient Times," in *The Monist*, Vol. XIV, No. 1, p. 87.) Hence, also, we cannot translate col. I, 59 by "for Nippur and Durilu" but by "for the Nippurian Dur-an-ki." For this translation compare the "Nippurian Bêl" in *Early Babylonian History*, p. 271, 5 and p. 272, 6. The occurrence of the "Nippurian Dur-an-ki" in this code proves that at the time of Hammurabi there already existed *another* Dur-an-ki, viz., that at Sippar (cf. the king of Sippar: *Enme-Duranki*, Zimmern, KAT³, p. 532) as well as that at Larsa (IV R 24, 50a; II R 58 No. 3, 25).

Enlil as "god of Dur-an-ki" is "god of the band of heaven and earth" (II R 54, 4a) and as such the "father of the gods" (K. B. VI¹ 46, 8), Shamash as the *En-me-* (i. e., *Hauptbefehlsvollstrecker* or "lord of commands") of *-dur-an-ki* is his "chief messenger," as such having the rôle of Nin-Girsu, the מלאך יהוה! Therefore is Shamash called the *ilu Ud-gishgal-lu* (IV R 19, 47, 48) i. e., the *Wolkensturm, finsterer Sturm* (Del. Hwb. p. 136 sub *irpû*)—a name attributed not only to Nergal (Shalmanassar II, Bronze Gates from Balawat, col. V, 4, 5), but also to NIN.IB=Nin-Girsu (II R 57, 51c).

In the "List of Proper Names" we miss badly the determinative "*alu*" before certain names as e. g. *alu NUN-KI* I, 64; *alu Shesh-ab-ki* II, 17, but *Ud-kib-nun-ki* without *alu* II, 25!

Likewise the determinative *ilu* ought to have been given in every case, and where it has been omitted (e. g. U.DAR: III, 54; IV, 47; I-gi-gi I, 14) this ought to have been indicated.

Also in the Glossary the transcription does not harmonize with that given in the text, as. e. g., *shu-bi-i-im* occurs correctly in the text I, 34, but in the Glossary it is given as *shu-be-i-im* etc., etc.

In the Introduction, p. xiv, we are told "the sign under No. 121 (sic! read 125), which has not been explained hitherto, has been made a *gunu* of No. 148" (i. e., UD). The sign in question is by no means new. Thureau-Daugin already in his *Récherches sur l'origine de l'écriture cunéiforme* sub No. 92 said of that sign "le signe paraît être le *gunû* de UD." An older form of this very sign occurs also in my *Early Babylonian History*, p. 428, seal l. 3: *Ur-ud-azag-ga*!

How one may be of quite a different opinion as to the meaning, understanding, transcription and translation of certain portions of this law may be illustrated by the first column of the Epilogue. I select just this portion because it is most important not only for forming a correct opinion of the religious teaching at the time of Hammurabi, but also because it throws a new and welcome light on the much disputed and vexed question as to whether there was in the Babylonian pantheon a highest god called *ilu* "god."

For the sake of convenience I shall put Professor Harper's and our translation of col. I side by side.

Professor Harper translates:

- | | |
|--------------------------|---------------------------------------|
| 1. When the lofty Anu, | 1. When the exalted GOD, |
| 2. king of the Anunnaki, | 2. the king of the (ilu) A-nun-na-ki, |
| 3. and Bel, | 3. (ilu) Enlil, |

- | | |
|--|---|
| 4. lord of heaven | 4. the lord of heaven |
| 5. and earth, | 5. and earth, |
| 6. he who determines | 6. who determines |
| 7. the destiny of the land, | 7. the destiny of mankind, |
| 13. committed | 8. to (ilu) Amar-ud (Marduk), |
| 11. the rule | 9. the principal son |
| 12. of all mankind | 10. of (ilu) En-ki (Ea), |
| 8. to Marduk, | 11. the (ilu) Enlil-ship (lordship) |
| 9. the chief son | 12. over the totality of men |
| 10. of Ea; | 13. had committed to him; |
| 15. when they made him great | 14. had among the I-gi-gi |
| 14. among the Igigi; | 15. made him great; |
| 17. when they pronounced the lofty
name | 16. had of Babylon |
| 16. of Babylon; | 17. its lofty name pronounced; |
| 19. when they made it famous | 18. had in the world-regions |
| 18. among the quarters of the world | 19. made it (=Babylon) famous; |
| 20. and in its midst | 20. had in its (=Babylon's) midst |
| 26. established | 21. an everlasting kingdom |
| 21. an everlasting kingdom | 22. whose |
| 24. whose foundations | 24. foundations 22 are as heaven |
| 25. were firm | 23. and earth |
| 22. as heaven | 25. firmly founded, |
| 23. and earth | 26. for him (=Marduk) established |
| 27. —at that time, | 27. —then at that time: |
| 45. Anu | 28. Hammurabi, |
| 46. and Bel | 29. the prince, |
| 49. called me, | 30. the exalted |
| 28. Hammurabi, | 31. who reverences the gods: me, |
| 30. the exalted | 32. for the purpose of making justice |
| 29. prince, | 33. in the land |
| 31. the worshiper of the gods, | 34. to shine forth, and |
| 32. to cause justice | 36. of destroying |
| 34. to prevail | 35. the wicked and the evil, and |
| 33. in the land, | 37. of preventing the strong |
| 36. to destroy | 39. from oppressing |
| 35. the wicked and the evil, | 38. the weak, |
| 39. to prevent | 42. to go forth |
| 37. the strong 39 from oppressing | 40. like (ilu) Ud (Shamash) |
| 38. the weak, | 41. over the Black-Heads(=man-
kind), |
| 42. to go forth | 44. to enlighten |
| 40. like the sun | 43. the land, |
| 41. over the Black Head Race, | 45. GOD, |
| 44. to enlighten | 46. viz., (ilu) Enlil, |
| 43. the land | 48. to further |
| 48. and to further | 47. the bodily welfare of the people, |
| 47. the welfare of the people. | 49. called by name. |
| 50. Hammurabi, | 50. Hammurabi, |

51. the governor	51. the shepherd,
52. named	52. the called one
53. by Bel, am I,	53. by (ilu) Enlil, am I,
54. who brought about	54. who gave in its completeness
55. plenty	55. plenty
56. and abundance;	56. and abundance;
57. who made	57. who made
58. everything	58. everything
59. for Nippur and Durilu 57 com- plete;	59. for Nippur-Duranki 57 com- plete;
61. the exalted	61. the exalted
60. supporter	60. beautifier
62. of E-kur;	62. of E-kur,
63. the wise king,	63. the strong king,
64. who restored Eridu	64. 65. who rebuilt Eridu; etc.
65. to its place; etc.	

The sense of this column is the following:

When GOD (1) Enlil (3) had committed (13) to Marduk (8) the Enlilship over the totality of men (11-12) and had done all that follows in ll. 14-26 then at that time (27) GOD (45) i. e. Enlil (46) in order to make the people fare well (47-48) called by name (49) Hammurabi (28): ME (31) to go forth like Shamash (40-44) with the avowed purpose of doing what follows in lines 32-39. Hammurabi, who wrote or had this code written, speaks of himself in lines 1-30 in the third person and from line 31ff in the first—therefore "me."

In justification of my translation and in order to show that there was at the time of Hammurabi a *highest* god called AN=ilū, with whom Dagan, Enlil, Sin, IB etc. had been or were in course of time identified, I may be permitted to give the following note here.

The god Anu, whom Harper finds in line 1, is not mentioned by one syllable in this paragraph—hence the correct transcription (u)il-*nu* il-*nu* si-ra-*nu* is wrongly translated by "when the lofty Anu." In line 3 there is in the original no "and" before ilū E=il—*and* if not, then lines 1, 2 can only be an *emphatic* apposition (as such standing at the beginning, *before* its noun!) to ilū E=il, and have to be translated by "when the lofty (or exalted) GOD, the king of the Anunnaki: Enlil, lord of heaven and earth etc." That this is the only correct translation follows from the following considerations:

1. Marduk receives in line 1 from AN=ilū and in line 3 from (ilū) E=il the *total* E=il-ship: line 11, i. e. the Enlilship. But the Enlilship can be given away by Enlil only and not by Anu and Enlil. Anu can dispose of the *total* An-ship i. e. the Anship, but never of the Enlilship.
2. Such so-called forms as *u-il-^{nu} il-^{nu} si-ra-^{nu}* (line 1) show us that they are *negatives*, therefore *unwarranted*. If they were *positives* they would be constructed: "Against this is not to be brought in the form *il-^{nu} si-ra-^{nu}* (line 2), which is a *positive*, therefore *unwarranted* form in the *negative* and not a *plural*."
3. Hammurabi, as is as in lines 31-33 that he is the *exalted* ilū E=il.

i. e., the called (one) by Enlil. Notice, he does not say here that he is called by Anu and Enlil! Hence Enlil, and Enlil only, called him. But if Enlil and Enlil only called him, then the *ilum* (AN) *u* (*ilu*) *En-lil shu-mi ib-bu-u* in lines 45ff. can only be translated by: " (at that time) GOD, i. e., Enlil called (me) by name."

The translation of this passage, then, hinges on the right understanding of the *u*="i. e." Are there other passages in the Cuneiform literature which likewise establish for this *u* (generally written SHI + LU) the meaning "i. e." or "viz."? Quite a number of passages might be brought in here. For our purpose, however, the following will suffice: In Tiglath-Pileser I, Prisma, col. V, 29ff. we read:

mâtâte (kur-kur-mesh) *Na-i-ri* 30 *rapshâte* (mesh-te) *a-na pat gim-ri-shi-na* a-bil 31 *u* (=SHI + LU) *nap-char sharrâni* (mesh-ni)-*shu-nu* 32 *a-na shepê* (mesh)-*ia u-kin-ni-ish*, i. e., the extended Nairi-lands in their totality I subdued, i. e., the totality of their kings I put under my feet.

Among Harper's own publications, *Letters of the K. Collection*, Vol. III, p. 276, No. 274=K. 81, Obv. ll. 8 ff. we read:

AN (mesh) *GAL* (mesh) *sha AN-e ù KI-tim a-na LUGAL EN-ia lik-tar-ra-bu ù* (=SHI+LU) (*gish*) *GU.ZA LUGAL EN-ia libbu (bu)-û AN-e a-na da-resh lu-kin-nu*, i. e., "may the great gods of heaven and earth bless the king, my lord, i. e., may they establish the throne of the king, my lord, in the midst of the world (sic!) for all eternity!" The blessing invoked upon the king consists in the establishment of an eternal reign—the latter sentence, then, explains the former!

The *u* in both cases cannot be translated by "and," for if "and" were intended then the Assyrian had to be according to Grammar ="-ma."

This *u explicativum*, as we may call it, in the sense of "i. e.," "namely," "viz.," is especially frequent in such connections as:

AN u(ilu) Dagan, and *AN u(ilu) Enlil*, etc., etc:

On the basis of this explanation two passages in our code receive a new light:

1. We know that Babylon was the city of Marduk; we also know that *AN si-ru-um* (*ilu*) *En-lil* (I, 1-3) committed to Marduk the Enlilship over the totality of men (I, 11, 12), i. e., Enlil transfers his rôle to Marduk (conf. XL, 9 ff.: "The black-head people, whose rule Enlil presented and Marduk delivered to me," i. e., from Enlil through Marduk to Hammurabi!) who now becomes the *An* (*ilu*) *En-lil* or *AN u(ilu) En-lil*. It is, therefore, possible that Babylon might be called also "the city of AN *u(ilu) En-lil*." Indeed so it is actually called in our code, col. XL, 63, 64: *i-na KA-DINGIR-RA-KI alim sha AN u* (*ilu*) *En-lil*, which, however, cannot be translated by "in Babylon, the city whose turrets Anu and Bel raised," but which must be rendered by "in Babylon, the city whose turrets GOD, i. e., the Lord (Marduk) raised." (Harper completely mistranslates this passage.)

2. In our code, col. II, 47, we read:

a-na AN+NIM u (=SHI+LU) *ilu Nanâ*.

Harper transcribes here: *a-na ilu Anu u ilu Nanâ*—but *AN+NIM* can never be read *ilu Anu*, nor *Anim* (Winckler), which latter ought to be at least *A-nim* and not *AN-nim*. The sign NIM has also the pronunciation "tum" and *AN+NIM* can be read only either *An-tum* or *il-tum*. *An-tum*

u *ilu* Nanā is "the goddess, viz., Nanā." That the goddess Nanā or Ishtar was indeed identified with An-tum, the goddess *kar' ēloxān*, is evident from II R 54, n. 3, 19. The same is true of XLIV, 15 where Ninkarrak is called the daughter of AN+NIM=An-tum.

These observations are, as was indicated above, of the highest importance for a right understanding of the much disputed question as to whether the Babylonians had a highest god called "*ilu*." Says Zimmern, KAT, p. 354: "Einen babylonischen Obergott Ilu, der in früheren Darstellungen der babylonischen Mythologie eine ziemliche Rolle spielte, giebt es nicht; vielmehr handelt es sich in den Fällen, wo *ilu* in den babylonischen Götterlisten aufgeführt wird, einfach um die appellativische Bezeichnung *ilu* 'Gott.'"

This cannot be maintained any more now. On the contrary, we have to say:

The highest honor a god or goddess could receive was to be identified with AN = *ilu* or *iltum*, which AN in such cases is not a mere appellative nor "determinative" but which shows us that the god who bears this title was now considered to be equal to that old god AN the "totality of heaven and earth," like unto whom there was no other god—who, therefore, stands in all the "lists of gods" at the very top. AN, although originally *the god (ilu)* was yet later on displaced by En-lil, the "lord of the wind." By thus displacing AN, Enlil acquired in addition to his old attributes (lord of the wind) also those of AN, i. e., he became the "god of heaven and earth," *the god kar' ēloxān*. At this time (i. e., when Enlil had become the god of heaven and earth or what is the same, the god of the whole of Babylonia) it seems that the oldest Sumerian cosmology and theology was developed: Enlil being now = "heaven and earth," AN (together with his brother KI) were made to be the "upper or heavenly" and the "lower or terrestrial" ocean. The reminiscence, however, continued to live on that AN was the *first* and *oldest* god of "heaven and earth"—hence the desire of the Babylonian theologians to identify their most favored god who happened to be, at one time or another, the most influential god of Babylonia, or to express it somewhat differently, to identify that god, whose city happened to be the capital of Babylonia, with the first and oldest god of the Babylonian "high and low-land": with AN the *ilu kar' ēloxān*, thus claiming for their god the necessary authority to exercise his power.

Again when Enlil was displaced by Marduk it is natural that he likewise should be called the AN u (*ilu*) Enlil, "the GOD, the LORD," thus having received his authority from AN through Enlil.

In this wise not only Enlil, Marduk, Sin, IB etc. were identified with AN, but even their respective wives had to become likewise the An-tum or il-tum *kar' ēloxān*, thus Ninlil, Sarpanitum (=Ishtar), Ningal, NIN-IB, Ishtar—all were=Antum or il-tum *THE* goddess at one time or another.

That *ilu* was indeed the name of the highest god, i. e., of *the god* who happened to be the god of the capital of Babylonia is evident also from the following:

1. The celebrated trilingual list of gods, II R 59, gives as the first and foremost god, who stands at the head and who precedes even Enlil:

dim-me-ir | AN | *i-[lum]*.

This very same AN is, in other lists of gods, said to be pronounced

A-nu-um (II R 54, No. 3; III R 69 No. 1; II R 54 No. 4)—hence the Sumerian AN had as "god" the pronunciation A-nu-um or i-lum. From this it follows that the god "ilu" is neither the Canaanitish El (as Winckler wants), nor is the word A-nu-um a pure Babylonian word. On the contrary, we will have to admit that the Semitic-Babylonian name for the Sumerian god AN was "ilu" and that the word A-nu-um is the Semiticized Sumerian pronunciation of AN, i. e., Anum is the Sumerian AN + Semitic nominative ending "u" + mimmaton "m."

2. The name of "Babylon" is generally written

Bâb-ili-ki or

Bâb-DINGIR-RA-ki or

Bâb-ili(mesh)-ki

Bâb-ilu-ilu-ki (Nebk. E. I. H., IV, 32).

Ba-ab-NI-NI. (K. 4309, 22 = Str. List 5997).

and is most commonly translated by "gate of god;" a translation which may mean either (a) *gate*, which god is (cf. Christ's "I am the door") genetivus subjectivus; (b) *gate*, which leads to god (cf. Christ's "by me if any one enters in he shall be saved") genetivus objectivus. And as Marduk was the god of Babylon it is natural to suppose that the "god" referred to in "gate of god" was Marduk himself. Babylon, however, was in existence before Marduk appeared in Babylonia. We may, therefore, grant the possibility that by this "god" in "gate of god" was meant originally another "god"—the god namely who was at one time or another (before Marduk appeared) the god of Babylonia as a whole. Furthermore, as Hammurabi is very anxious to identify Marduk with AN *u(ilu)Enlil*; he calls Babylon "the city whose turrets AN *u(ilu)Enlil* raised"—gods of whom we know that they actually ruled over the whole of Babylonia—we may conclude that the *ilu* in *bâb-ilu* signifies always the *highest* god: may the highest god have been AN, i. e., *ilu*, or Marduk or Enlil, therefore also the pluralis majestaticus *Bâb-ili(mesh)-ki* or *Bâb-ilu-ilu-ki* or *Ba-ab-NI-NI*! For *NI-NI=i-li=plural* (of majesty) see XLII, 45: AN *ra-bu-um a-bu NI-NI*, i. e., "the great *ilu*, the father of the gods."

This is important for understanding the "proper names" composed with *ili* (mesh), *ilu-ilu*, or *NI-NI*. In such names the *ili*(mesh) etc. is simply the *highest god*—whether he was considered to be Marduk or Enlil or Sin etc. does not matter. Now we also understand the writing *Bâb-(ilu)KUR.GAL-ki*=Babylon (II R 57 Rev. line 70). *(ilu)KUR.GAL* is according to V R 44 III, 41 =Enlil resp. Bêl. *Bâb-(ilu)KUR.GAL-ki*, then, may be read *Bâb-Bêl*: the gate of Bêl—a reading which would show us that the "ilu" at one time or another was the old Enlil—hence Babylon "the city of GOD, i. e., Enlil"! But the name also demonstrates beyond the shadow of a doubt that Enlil was *ilu*, the god $\kappa\alpha\tau' \acute{\epsilon}\xi\theta\eta\nu$ and that *Bâb-(ilu)KUR.GAL-ki* may therefore be read also *Bâb-ili-ki*. *(ilu)KUR.GAL*, because = *ilu Enlil*, is also = *ilu E-kur*. But *ilu E-kur* is = *A-nu-um* resp. *ilum*. (See my "Bel, the Christ of Ancient Times," *The Monist*, Vol. XIV, No. 1, p. 83, Note 6)—hence *ilu KUR.GAL* = *ilu(m)*, and *Bâb-(ilu)KUR.GAL-ki* = *Bâb-ili-ki*.

In conclusion I should like to rectify two minor mistakes of Professor Harper:

The word *i-nu-mi-shu* in I, 27 is registered in the Glossary, p. 153, as a word by itself—as if there existed in Babylonian an *inumi*! This is wrong! *i-nu-mi-shu* is contracted out of *ina úmi-shu*. For such contractions with *ina* cf. among other places also K8531, Rev. 4: *ina nu-ush-shu* where the duplicate Rm. 126, Rev. 4, has *i-nu-ush-shu*. Hrozný's Grammar, *Mythen von dem Gotte Ninrag*, p. 48, is likewise not what it ought to be, for he takes *inushshu* to be a Present tense!

The expression "and to further the welfare of the people" (I, 47, 48) does not belong to Hammurabi, but to AN u (ilu) Enlil, therefore the "and" which is not found in the original is also not necessary here.

HUGO RADAU.

CHICAGO, Nov., 1904.

P. S. Since the above was written there appeared in the A. J. S. L. L., Vol. XXII (October, 1905) Professor Harper's Commentary to the Code of Hammurabi,—which, however, contains no corrections, and Harper tells us, for instance, (p. 145) that Ninazu is a goddess. Apparently he has not seen such passages as II R 18, 40 = A. S. K. T., No. 11, col. iv, 40.41:

"(*dingir*) *Nin-ki-gal dam (dingir) Nin-a-su-ge | (ilu) ditto al-ti (ilu) ditto*," i. e., "Ninkigal the wife of Ninazu"—hence the latter must be the husband, i. e., he must be a *male* god! Cf. also II R 59 Rev. 34.35 where *Nin-ug(!)-da* appears as the wife (*dam-bi-sal*) of Ninazu. Not less surprising is Harper's statement (*loc. cit.*) that Zamama is a goddess—notwithstanding the fact that he himself calls him (*loc. cit.* p. 107) "the great warrior, the chief son of Ekur."

HUGO RADAU.

CHICAGO, ILL., July, 1906.

CONGRÈS INTERNATIONAL DE PHILOSOPHIE. Rapports par Dr. Ed. Claparède. Geneva: Kündig, 1905.

This is the secretary's report of the eleventh session of the International Congress of Philosophy, held at Geneva, September 4-8, 1904. The first part contains the rulings of the congress, the program, and lists of members, after which follow the leading addresses with portraits of the speakers. The frontispiece to the volume is the portrait of the venerable Honorary President of the Congress, M. Ernest Naville. Among the papers read at this memorable congress were: The Task of Logic, by Dr. W. Windelband; The Individual and Society, by M. Vilfredo Pareto; Neovitalism and Finality in Biology, by J. Reinke; Moral Personalities, by A. Borstel; The God of Aristotle, by Ch. Werner; "The World" of Descartes, by K. Jungmann; The Dominant Ideas in the Philosophy of Tolstoy, by Paul Biroukof; An International Language, by Louis Couturat.

TRAITÉ DE PHYSIQUE. By O. D. Chwolson. Translated by E. Davaux. Paris: Hermann, 1906. Pp. 407.

E. Davaux, marine engineer, has translated Prof. O. D. Chwolson's work on Physics from the Russian, with the assistance of a German edition previously made under the supervision of the author. Messrs. E. and F. Cos-

serat, the former, professor of science at the University of Toulouse, the latter, chief engineer of the eastern railroads in France, have added notes on theoretical physics.

Professor Chwolson's prominence as a physicist is fully established among his colleagues. The present translation is an excellent one. It seems to be fully as reliable as the German version of the same work. The book is printed on good paper in clear type, and the many figures in the text are well done.

DER URSPRUNG DER ISRAELITISCH-JÜDISCHEN ESCHATOLOGIE. Von Dr. Hugo Gressmann. Göttingen: Vandenhoeck & Ruprecht, 1905. Pp. viii, 378.

Prof. Hugo Gressmann of Kiel publishes in the present volume a series of books on the religion and literature of the Old and New Testaments, a careful enquiry concerning the origin of the Israelitish and Judæan eschatology, and we are glad to recognize the ability with which he has accomplished his task. His method is historical and critical. He follows Eichhorn mainly, but also Gunkel, Wellhausen, Giesebrecht, Smend and others, and handles the subject with independence and not without originality.

His work is divided into two parts,—the eschatology of misfortune, and the eschatology of salvation. These were the two thoughts which dominated the formation of a belief of the great events that were expected by the pious Jews. The Yahveh revelation was seen in earthquakes, storms, volcano-eruptions, in fire and thunder, in war and pestilence, etc., and the day of Yahveh was expected to come like a catastrophe upon the world.

But this eschatology of misfortune was offset by the hope of salvation, that God would not be forgetful of his promise of salvation to his chosen people. The idea of the Golden Age played an important part in this connection. A new covenant was expected, nature to be reclothed in an ideal shape and paradise restored. The central figure of the return of the Golden Age was the Messiah, later on identified with the Son of Man.

Professor Gressmann has not devoted a special chapter to Christianity, but we may add that the Jewish eschatology is the stepping stone between Judaism and Christianity, and for that reason the results in this field are of great importance. They are sure to throw light upon the problem of the origin of our own religion. We do not hesitate to recommend the book to the attention of Biblical scholars.

LA PHILOSOPHIE DE CHARLES RENOUVIER. Introduction à l'étude du néo-criticisme. Par Gabriel Séailles, professeur à la Sorbonne. Paris: Alcan. 1905. Pp. iv, 400. Price, 7 fr. 50.

M. Séailles believes that in the history of French philosophy of the nineteenth century Charles Renouvier will hold a place of honor near his great compatriot Auguste Comte. Trusting in his critical method, careful to show the far-reaching importance of his principles, convinced, too, that error is the cause of evil, Renouvier is not slow to express what he believes to be the truth. Logic, psychology, natural philosophy, moral and political history—all of these he has touched upon and investigated.

M. Séailles intends his book to be an introduction to neo-criticism, a perfectly clear exposé of a doctrine difficult of comprehension. He has in-

serted a large number of quotations; he has gathered together a number of formulas, and has expressed himself throughout with force and precision. Criticism is subordinated to intelligence of thought and serves only to bring it into prominence. The author is especially interested in the exposition of Renouvier's early philosophy, convinced that upon this will rest his significance with posterity; and he does not emphasize the religious beliefs to which the great philosopher arrived late in life except to point out how they enervate and contradict the original theses of neo-criticism.

The work of M. Séailles will be a valuable guide to those who wish to be initiated into neo-criticism, and a useful resumé of the work of the founder of this celebrated system of philosophy.

LE MORALISME DE KANT ET L'AMORALISME CONTEMPORAIN. Par *Alfred Fouillée*. Paris: Félix Alcan, 1905. Pp. 375.

Alfred Fouillée is one of the most forcible and fertile writers on philosophical subjects in modern France, and he has devoted his special attention to the moral and social problems of our own age. The present book is intended to complement his former labors of moral theories by pointing out the contrast which obtains since the rise of Nietzsche's philosophy between moralism and unmoralism,—the latter being that system of philosophy which looks upon morality as a fraud and as positively injurious to the development of the super-man, the representative of higher humanity.

Fouillée contrasts Kant's formal moralism to Nietzsche's unmoralism. He himself takes a stand which is sympathetic with Kant, although he accepts the views of the sage of Königsberg not without restrictions. The principle of unmorality shows itself in two ways, as a hankering after pleasure, and a hankering after power. Both of them are will-o'-the-wisps which should be discarded, while Kant's system remains in force, and Fouillée would only deem a proper adjustment to our modern acquisitions in science necessary. He says in conclusion:

"If nature be only the material mechanism, Kant would be right in saying that morality is superior to nature in so far as morality implies a law of finality which is different from the law of material causation; but if nature be the All, and comprise also ourselves, if it be the entirety of life and of thought, then morality with the intelligent finality which it involves is not superior to nature—then it is the higher nature. Nature is the great All and morality which the worshipers of pleasure and of power try in vain to suppress is a part of the All, but being that which is pregnant with things to come it is worth more than the whole in the sense of the Greek saying *πλεον ημισυ παντός*, i. e., 'the half is more than the whole.'"

FOUNDATION OF A LAY CHURCH

WHAT is the reason that so many people, and sometimes the very best ones, those who think, stay at home on Sunday and do not attend church? Is it because our clergymen preach antiquated dogmas and the people are tired of listening to them; or is it because the Churches themselves are antiquated and their methods have become obsolete? To many these reasons may seem a sufficient explanation, but I believe there are other reasons, and even if in many places and for various reasons religious life is flagging, we ought to revive, and modernize, and sustain church life; we ought to favor the ideals of religious organizations; we ought to create opportunities for the busy world to ponder from time to time on the ultimate questions of life, the problems of death, of eternity, of the interrelation of mankind, of the brotherhood of man, of international justice, of universal righteousness, and other matters of conscience, etc.

The Churches have, at least to a great extent, ceased to be the guides of the people, and among many other reasons there is one quite obvious which has nothing to do with religion and dogma. In former times the clergyman was sometimes the only educated and scholarly person in his congregation, and he was naturally the leader of his flock. But education has spread. Thinking is no longer a clerical prerogative, and there are more men than our ministers worthy of hearing in matters of a religious import. In other words, formerly the pulpit was naturally the ruler in matters ecclesiastic, but now the pews begin to have rights too.

Wherever the Churches prosper, let them continue their work; but for the sake of the people over whom the Churches have lost their influence the following proposition would be in order, which will best and most concisely be expressed in the shape of a ready-made

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FOUNDATION OF A LAY CHURCH. (CONTINUED.)

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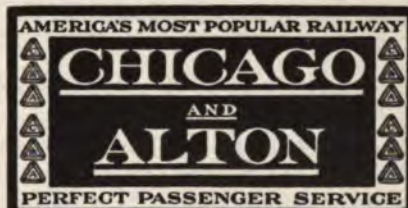
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* * *

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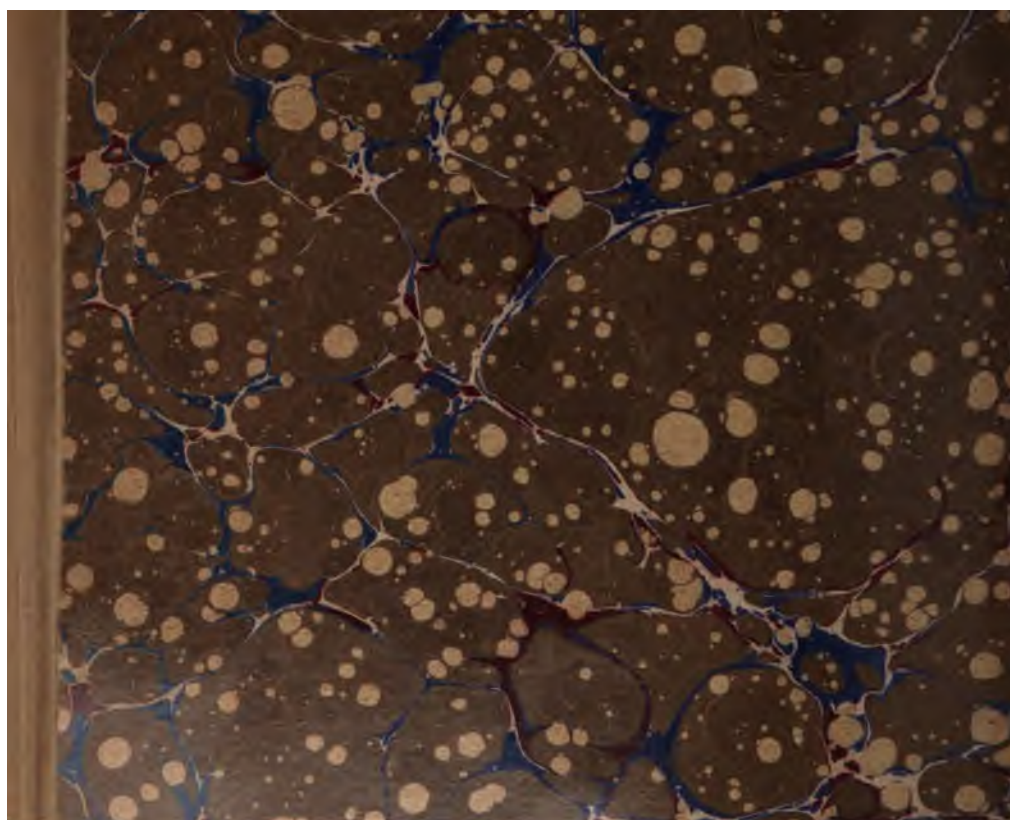
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